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PRACTICAL

ELECTRO-THERAPEUTICS.

BY

WILLIAM F. HUTCHINSON, M.D.

"That He Who Runs may Read."

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TO

WILLIAM A. HAMMOND, M.D.,

SURGEON-GENERAL U. S. A. (RETIRED),

THIS VOLUME OF PRACTICAL HINTS IS DEDICATED AS A TOKEN OF REMEMBRANCE OF OUR WAR SERVICE TOGETHER, AND IN RECOGNITION OF HIS EMINENCE AS A PRACTICAL NEUROLOGIST.

MICROFILMED AT HARVARD

PREFACE.

It has been principally upon the advice of the publishers of this volume, that I have brought together in a book the results of my fifteen years' labor in the special domain of electricity as employed in medicine and surgery.

So many letters have been received at different times from different places inquiring for concise directions how to use electricity for this or that disease, that it seems as if a work containing nothing but such suggestions, all of them the direct outcome of personal experience, would be useful to the general profession; and with such hope alone—to such an end only—the book is written.

As strictly practical in intent, all theories have been avoided, and only such illustrations inserted as present a few instruments of my own device; for both theory and technical terms are uncared for by the busy worker who is only looking for aid from electricity—not for a panacea.

It will be observed that little mention is made of Static Electricity. This is because its use has practically debarred the general practitioner by expense of machines and difficulty of managing them, and because its use in my own hands has not been followed

by better results than that of faradism, which is simpler of application and more accessible.

And I believe that the chapters upon electro-surgery will be of much assistance to practitioners at a distance from centres who are anxious to try for themselves the application of electricity by galvano-causty and electrolysis, which they read of in medical journals.

WILLIAM F. HUTCHINSON.

159 HIGH ST., PROVIDENCE, R. I.,
April, 1888.

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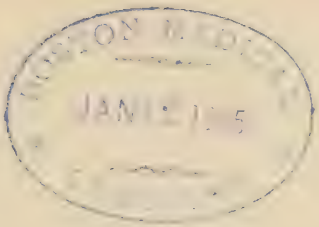


PRACTICAL

ELECTRO-THERAPEUTICS.

CHAPTER I.

THE OUTFIT.

THE addition to the armamentarium of the general practitioner of medicine of so powerful an agent as electricity, and the mystery which, as yet, conceals nearly all of its phenomena, seem to demand that some thoroughly practical series of directions for its systematic use shall be prepared and made public. There are numerous well-written and comprehensive works in existence upon the value and use of electricity in medicine, and each of these has its hardly-earned place upon the specialist's table. Each one begins by demanding for its proper comprehension an amount of study of its preliminary chapters upon electro-physics and electro-physiology, and an acquaintance with the many machines that are set forth in excellent cuts upon its pages, such as no busy doctor can possibly give—such as he will not spend time upon. Certainly no claim is made here that an accurate knowledge of the laws and formulæ which

are known to govern electrical phenomena, is not a valuable addition to a physician's budget of information; it is intended, in the chapters which will follow this, to demonstrate that they are not absolutely essential. And while the tendency of modern practice has been very strongly toward the development of specialties in medicine during the past ten or fifteen years, so that the general physician is occasionally puzzled to know just what is likely to remain for him to do after another decade of like progress, it should be remembered that there will come an end to this. While in large cities it is probable that branches demanding especial ingenuity and especial preparation, such as diseases of the eye and ear, electro-therapeutics, etc., will always demand men who will study for those departments alone, there is fast coming the time throughout the country when the general practitioner must and will reassert his superior claim to attend his patients for any and all diseases. The advance in medical education along the whole line makes this practicable in the near future in America, as it has always been in Europe, where the foremost specialists are men in large family practice.

It is to such men as these—men who need in their rooms an electrical machine as they do an amputating case, to be used about as often—that this work is addressed. For men who neither know, wish to know or care about the meaning of anode or cathode, rheotome or rheostadt, a farad or a weber, and yet who *do* know that a faradic current is one of the best possible applications for muscular rheumatism, and one of the best diagnostic aids in certain nerve

lesions, and who need plain directions how to use the agent in such cases, it has been written. It is said that such directions must be lacking in precision, because no accurate system of dosage has yet been devised of a power subtle enough to escape measurement, *i. e.*, that a faradic current cannot be weighed or measured like a dose of quinine. I cannot quite agree with this statement, for, with the instruments which can now be obtained at a very moderate cost, electrical currents may be applied to patients from day to day with as much accuracy as cupping-glasses, and as little risk. To do this, and do it well, it will only be necessary to observe the following directions for special cases, which will, it is believed, cover all the salient points wherein the general use of electricity is indicated. Beyond this, if prolonged or complicated treatment should be necessary, or if the action of the current should give rise to unexpected or alarming symptoms, it will probably be best to refer to the expert, whose life is spent amongst such cases, and who may be consulted in such need. Where the surgical use of electricity is required, it is improbable that the general practitioner can accomplish much. The instruments required are unwieldy, expensive, difficult of management and maintenance, and really play so minor a part in the grand domain of surgery, that there are very few operators who care to lay down the scalpel for the cautery knife or wire. And yet, as will be seen later, results have been obtained in many cases where the knife could not be used, where only galvano-surgery was admissible. Here the specialist must again come in, and all scientific surgeons will rejoice at his presence in the hour of need.

To do good work one must have good tools. This is especially true in electricity, where imperfect instruments, either of production, conduction, or application, will defeat the most painstaking endeavors. To attain the best results in electro-therapeutics, in fact, to attain *any* satisfactory results, it is absolutely necessary that efficient machines, perfect (as nearly as may be), conducting wires and a number of electrodes of different shapes, should be provided and kept in a high state of efficiency. An electric machine in which any form of acid is used to excite a current flow, needs unremitting care. Shut up in a box for days at a time, acid fumes find their way through the best preventives, and connections are oxidized or corroded. Zincs lose their amalgam, carbons grow rough and soft, and any sudden movement of the plates usually results in their fracture. Cords become oxidized at their ends, and only carry the current by jerks or refuse duty altogether. Electrodes are covered with cupric acetate where brass joins carbon, or over the entire face of metal plates, and will not transmit the flow. All these uncomfortable obstacles depend upon simple carelessness, either in purchasing instruments or in looking after them when bought. Let us take the machines first. There is one fact to be borne in mind from the outset, namely, that no instrument has yet been made satisfactorily combining in one box galvanic cells and an induction coil. The temptation to purchase such a one upon the score of convenience and economy is strong, but the test of experience has shown that they will not last; that however bright and effective they may be at first, deterioration begins promptly and they soon

become useless. There will then be needed three separate instruments, viz., a 24-cell Grenet galvanic, portable, a 30-cell permanent galvanic, office, and a compact reliable induction coil, giving a power with half-drawn helix stronger than the purchaser can well bear. The first named will be needed for out-door daily use, and may be used at the bedside in cases such as acute neuralgia, sick headache, etc. The current will be of high tension, and will prove enough, when freshly charged, to use for electrolysis of small nævi, bursæ, etc. The best one at present in the market, in my opinion, is the 24-cell chloride of silver battery, manufactured by the Gaiffe Company, of Paris. It is small, compact, carries well, and has no connections beneath the switch-board which are difficult to reach. But batteries almost as good, and answering our purpose equally as well, are made by many American manufacturers. When filling the cells if a little extra care be taken not to get any of the fluid, which is the common solution of potassic bichromate in dilute sulphuric acid, on the outside of the glass, much destruction of the case will be avoided. They should not be quite half full; if more is put in, the plates may cause an overflow when immersed. When through using the instrument, I am in the habit of rinsing off the plates by dipping the whole series into a basin of hot water. This saves both the zincs and the top of the cell-cover below, which will be quickly destroyed if the acid solution drips upon it. For office work, which includes, to my mind, all cases of central lesion, the instrument just described is quite incompetent. The high-tension current which it produces is, with its

great velocity and harsh effect upon the surface nerves, as well as its excessive stimulant action upon the nerves of special sense, dangerous in the extreme in non-expert hands, and rarely employed about the centres by specialists. Duchenne records a case[1] where a careless application of this kind to the head caused sensation of a bright flash of light and subsequent total blindness. For all central applications, therefore, whether to cerebrum, cerebellum, cerebro-spinal axis, spinal cord, or nerves of special sense, another battery is needed. Flemming, of Philadelphia, has lately made two or three for my patients which have proven especially useful. And as types of this class of instruments I regard them the best. The cell is a modification of Daniell's; that is, it is a copper, zinc, and water element, with a packing of paper pulp separating the two metals.

The connections between the jars are of platinum, which does not oxidize, and the battery is exceedingly permanent. Being of large internal resistance, possessing little current tension or velocity, with considerable quantity of electro-motive force, the resultant current is very soft, easily handled, and can never do harm with any number of cells which a physician would need for medical purposes. Flemming makes these batteries of any size for about $2.50 a cell, and twenty-four of these, contained in a plain box, with a key-board connecting on any number of cells from one to twenty-four, a current changer for reversing the direction of the flow, and two screw-posts for the cord tips, make a battery that will do all the work

[1] De l'Electrisation Localisee.

needed in any office, and be at the same time permanent, neat and reliable. All that is needed when the current begins to grow weak is to add a few crystals of cupric sulphate and a little water, close the circuit by connecting the screw-posts with a bit of wire, and in a few hours it will again be in good order. The three points mentioned above—permanency, neatness, and reliability—are absolutely essential for good work in a battery of this class. In the portable one before described, permanency is impossible, neatness difficult, and reliability uncertain, from the very nature of its construction ; but this is a matter of less consequence when one has his office instrument to fall back upon, and is sure of finding it in good order ; besides, the portable battery is only intended for cases requiring less care and skill than the office instrument. It is necessary that the current shall be permanent, in order that the patient may have the same amount of electricity tomorrow as yesterday from the same number of cells —in default of which or of a milliampere metre, there can be no system of dosage. It must be neat, so as to be a welcome visitor as well as a useful one, and it must be reliable, so that the temper of the practitioner may not be expended upon an unruly machine instead of upon a nervous patient. And I know of few things more exasperating than to have a fidgety woman watch the doctor trying in vain to discover why the blessed battery will not go, when she has been promised quick relief from its magic healing power, and is waiting. About then, one is willing to pay largely for reliability or to pitch the whole thing out of the window—it matters little which.

Flemming makes one of the best faradic machines in the market. It is both simple and effective, the two requisites in an induction apparatus. What is needed here is a well-insulated secondary or outer coil of considerable length, a short primary coil, a battery cell which will last some time without change of fluid or without spilling it in transit and which produces a high-tension current, short, unsoldered connections between cell, coil, and vibrating hammer, and a conspicuous absence of the numerous devices for slow and rapid interruption, which look so pretty upon the key-board, and which so quickly get out of order, and become worse than useless. In the last instrument of this kind that I have had made for me, there are no connections made with the primary coil at all, it being my belief that there is no therapeutical difference in effect between the two—that the secondary is alone needed, and that the additional attachments required to use both are an added source of deterioration in effectiveness. It will be found by practice that the numerous small induction machines in the market, of which Gaiffe's is the type, are practically useless for medical purposes. The little mercuric bisulphate cells and short coil give a current of sufficient tension, it is true, when freshly charged, to contract muscles, but quite devoid of therapeutic value, from the absence of quantity—that mysterious quality of electricity which influences chemical, as well as trophic and vital change. They are valuable only as toys, serving to amuse the patient while the doctor works away at the disease with other weapons. And right here, I am satisfied, is the cause of the want of faith in electricity as an

absolute curative which a large majority of general practitioners feel. Our best men, when asked their opinion as to its value, are apt to shrug their shoulders significantly and say nothing, or give an evasive answer. They have tried it and failed. But the failure was the fault of the operator, in his lack of knowledge of instruments—not of the agent employed. And it is a mystery, why a little machine of undoubted activity cannot produce vital effects which a more powerful one easily attains, when the physical phenomena evoked by both are so alike, but one which promptly disappears in the light of the above explanation. Let such playthings alone; they do but serve to undermine your confidence. And yet, in the report of the New York Academy of Medicine for April 21st, 1883, Dr. Beverly Robinson is reported as saying "as much benefit was received (in a case of opium poisoning) from artificial respiration as from the intelligent use of the faradic current. The *battery*[1] used was the small portable one of Gaiffe." Had really intelligent use of the faradic current been made, with a competent machine, it is probable that no need whatever of artificial respiration would have been experienced.

Leakage of Machine.—Flemming's faradic machine has the additional advantage of non-leakage. By a simple lever movement, the opening through the rubber top of the cell is shut water-tight, and the box may be turned upside down without spilling a drop of the fluid; something which one learns to appreciate after spoiling a pair of trousers and a carriage rug or two, to say nothing of the box.

[1] Italics are mine.—W. F. H.

Next as to cords. Always provide those made of fine copper wire twisted into a small rope properly covered. More than half of those that come with medical batteries are made of tinsel, which have but one thing to recommend them—their flexibility—against so many disadvantages of imperfect conduction, rapid oxidation, and slight strength, that they should never be purchased. When the order is given, specify conducting cords of fine copper wire. The form of tip is also of importance. Any form will wear out and break from the cord, and it is evident that the one wearing longest is the best. And this is the one that can be replaced in a few moments by the doctor, without the necessity of a mechanic, being the form used by most manufacturers, viz., a stout wire point, with a double loop at one end to twist the conducting wire into. When, through constant friction and much use, the strands of copper wire have become frayed out, or so far disorganized by the galvanic action as to snap off, or corroded through with verdigris, it is only necessary to clip off an inch or two of the cord, strip the covering from another inch or two, brighten the tip with acid, and attach as before. One cause of much discomfort in central galvanic sittings, *i. e.*, flashes of light, phosphenes, is frequently due to the loose way in which cords are fastened to tips, and may be quite avoided by being careful that the twists of cord are well tightened around the metal tip when attached.

Lastly in the outfit come the electrodes. For general galvanic treatment there will be needed two flat sponge-covered pads, to be placed anywhere under the recumbent figure, two oval carbon plates, 3x2 inches, two carbon buttons, 1½ and 3 inches in

diameter, one long, narrow metal plate, made double, for the sympathetic ganglia, and one or more penis tubes. All these except the latter should be covered with wash leather, and it will be better if a thin lamina of sponge be placed between the leather and the carbon, so as to retain the moisture longer. For faradic use, in addition to the flat sponges before mentioned, which will be found quite indispensable, there should be provided half a dozen sponge-holders, armed with sponges about three inches in diameter, a fine wire brush and an eye-cup; and for use with both currents, two or three handles, best of hard rubber, which should fit the screw-thread of all electrode screws so as to be entirely interchangeable. With these, and a few needles, if the destruction of nævi is to be considered, the doctor will be ready for any emergency in which electricity can be used in medicine. There will, of course, come times when a special appliance will be needed; but stout brass wire, a pair of cutting pliers and a little ingenuity will readily supply such need. Let us recapitulate the outfit and see how much this all is going to cost in round numbers:

One galvanic battery, portable	$35 00
One galvanic battery, office	35 00
One Faradic machine	30 00
Eight galvanic electrodes with handles	15 00
Six sponges and holders	6 00
One wire brush	1 50
One eye-cup	1 50
Or a total of, say	$114 00

From this there will be some trade discount, probably enough to make the amount $100, net.

I do not think that much better than this can be done.

CHAPTER II.

ELECTRO-DIAGNOSIS.

By means of carefully conducted electrical tests, a differential diagnosis between centric and excentric nerve lesions may be made with great certainty, without other apparatus than that already described. It is necessary to employ both constant and induced currents for this purpose, and the diseases wherein doubt may be set at rest in this manner are but few. Its aid is chiefly called for in hemiplegic conditions, in muscular atrophy, in lead-paralysis, in feigned diseases, and as a means of determining if animal life be extinct; and although there are various other conditions where electro sensibility is altered, it does not thus far appear that any observer has made a satisfactory series of tests with any useful or indeed any result whatever.

In preparing for an electric examination two essentials must be provided for: a competent knowledge of normal electro-contractility and a healthy standard. The former may be acquired at the bedside in a moment by studying the action of a healthy muscle upon the observer's person under a measured electric force, and comparing it with a bystander also healthy. As the latter usually objects, the experiment may be confined to the student. With one electrode of an induction coil in action held in the hand, or placed at

an indifferent point upon the body, and the other attached to a carbon button, press the latter firmly upon the muscle to be examined, about the middle of its belly, and note (*a*) the amount of contraction, (*b*) the duration of contraction, and (*c*) the rapidity with which it follows electric stimulus. Do this accurately the first time if possible, since a second trial with the same muscle will not give the same result, the inherent muscular contractility having been aroused by the first electric application.

Supposing the case to be hemiplegia, the patient should be placed so that opposite muscles are in the same relative position and relaxed. Place the electrodes as directed above, first upon the healthy side, and note carefully the three points spoken of. Transfer them to exactly the same places upon the affected side, and mark the difference. If the muscles of the latter contract much more powerfully than the former, it is probable that the disease is accompanied by an increase of nerve force, an increased irritability, due to a similar cerebral condition. If a contrary result is obtained, a depressed or anæmic condition is inferred. If the contraction holds firmly for several seconds, or as long upon one side as the other, the disease cause is probably excentric; if it quickly gives way, extending beyond the circuit of electricity in waves that degenerate into fibrillar contractions throughout the limbs or even to more distant parts, the origin of trouble is central, and this localization is rendered more probable if a few seconds intervene between closing circuit through a muscle and its response. In all cases the current should be strictly confined to one muscle at a time.

It frequently happens that no strength of induced current will produce the slightest muscle contraction. But electric tests should not stop here. Change wires to a galvanic battery, and repeat the process, using current enough upon the healthy side to give a sharp contraction when circuit is broken with the negative electrode. Should no response come from the affected side from such application, with both electrodes pressed firmly against the skin, reverse poles sharply two or three times. If the muscle is still quiet, it is probable that central degeneration has progressed far enough to stop initial supply of nerve force, or that an effective barrier to its flow exists somewhere in the nerve tract.

I have been utterly unable to go farther than this with practical result. Measurement of the amount of failure to respond to electric stimulus is a delicate, difficult operation, rendered more so by our ignorance of the exact normal amount of inherent muscle irritability, if indeed any such standard exists. Every study that I have made of electric diagnosis in spinal cord disease, or where it was desired to locate accurately a central lesion, has had a mortifying way of opposing its results to general symptoms, and in post-mortem examinations the latter have usually had the best of it. In a general way, as an important adjunct to rational signs, electricity is of great importance, and should be thoroughly understood. In progressive muscular atrophy, it occasionally happens that a portion of a muscle fails to respond to stimulus while the rest answer fairly well, and this condition is not found in my experience elsewhere. The common extensor of the fingers is perhaps the best upon which

to demonstrate this condition. Lead-palsy gives a general loss of muscle tone, and corresponding difficulty in obtaining electric response; but galvanism has done wonders in every case that has been so treated by me. Under its influence strength of contraction has steadily increased, until the induced current came into play, and natural irritability was restored.

There is nothing equal to a strong faradic current in detecting malingerers. A famous baseball pitcher applied to me a couple of years ago for treatment for his arm, which he declared was useless from overstrain. Suspecting that his condition was feigned, his arm muscles were tested carefully without obtaining the smallest difference in electric response, when he promptly gave up the imposition and returned to duty. As I have elsewhere stated, it is scarcely possible that any malingerer, however determined, can resist the persuasive power of an intense induced current applied to muscle motor points.

For determining death, electric tests are certain. Muscles retain electro-contractility for a short time only after life has departed, varying from one to three hours, in no case exceeding four, and if no response is received from a series of powerful shocks transmitted through needles thrust into a muscle, life is certainly extinct. If the smallest wave can be obtained, it is unwise to relax efforts at resuscitation. Cataleptic states, which closely simulate death, may thus be unerringly determined.

As a means of prognosis in local paralysis these tests are exceedingly useful. Owing to its exposed position, the deltoid is more liable to injury from blows

than most other muscles, and a shock received by the circumflex nerve in any part of its course is apt to be followed by paralysis of the deltoid with consequent atrophy. There are few lesions more difficult of cure than this, but as long as either direct or induced current evokes fibre, not fibrillar contractions, the case is not a hopeless one, although the treatment necessary to restore wasted bundles is necessarily very tedious and protracted. In one case, where a young man received a blow upon the shoulder by being pitched headlong from a wagon, coming to me seven months afterward, two years were needed to effect a cure, which was, however, complete.

Where no electro-contractility remains, and no effort of will can produce motion, I am accustomed to regard the case as practically hopeless.

Some brilliant results have been obtained in paralysis following diphtheria and scarlet fever. There is almost always marked loss of electro-contractility to an induced current in these cases, but galvanism never fails to start muscles into action, and after a few days faradism may be substituted. It is best to make the changes as soon as the latter is effective, because it is more active in its operation than the former, owing to its higher tonic power and great rapidity of current interruptions, which imperceptibly act as a series of minute blows or separate stimuli to dormant vitality.

Occasionally, continuous slight pressure upon a nerve trunk will produce paralysis of muscles supplied by its branches, and considerable alarm is felt lest the cause should prove centric. A familiar instance of this is afforded by pressure upon the median

nerve by the head, when one goes to sleep with his arm for a pillow. Here electric diagnosis comes into play, and determines at once that only muscles supplied by that nerve are affected, and by producing normal contractions dissipates fear at once. A few days of regular faradism is usually sufficient to cure the most obstinate of these cases. As a means of detecting and locating metallic substances buried in the body, the new electric induction balance is probably unrivalled. In its primitive condition, it failed to find the bullet that killed our lamented Garfield, but it is now improved so as to be quite reliable. By its aid, the presence or absence of bullets, or any metal beneath the surface, may certainly be established—a matter of no small value in judicial investigations, as well as in surgical practice; and the electric probe, a slender needle, tells with unfailing exactitude just where the foreign body is. This instrument of precision bids fair to make field-work of military surgeons much less troublesome and more accurate than ever before, and must result in immense benefit to the wounded, by saving tedious exploratory cutting. It is a triumph of modern invention.

CHAPTER III.

GENERAL FARADIZATION.

THE conclusion of Chapter I. left the physician, who has thus far followed my suggestions, in possession of all the instruments necessary for the satisfactory and continuous application of electricity in general practice of medicine; and if any special appliance or instrument be needed beyond those suggested, any reputable maker will furnish them. The very best American instruments, and they have no superiors, are those made by Flemming, of Philadelphia, and the McIntosh Company, of Chicago. Let us now see what he can do with them, and in the very beginning it is best to say that the scientific use of electricity involves much less time and trouble than is generally supposed. A large proportion of both have been wasted in an endeavor to persuade nervous patients that they will not be hurt, or in the still more vain endeavor to coax some nuisance of a battery to work. The latter is, we trust, no longer to be feared; the former is eternal. But, if the physician's mind is thoroughly imbued with the two following primary axioms of electro-therapeutics, it will be an easy matter to convince the subject of their value:

First, *never hurt a patient.*

Second, *never tire him.*

It is difficult to say which of these rules is the more

imperative, although if there is any difference in value, it belongs to the former. Nearly every educated man or woman has a vividly distinct remembrance of some electrical school experiment, or some trial of an electrical machine at a fair, where a shock was received sufficiently severe to galvanize the memory into prompt activity whenever it is recalled the whole life after. "Now, doctor, you won't hurt me, will you?" is one of the first questions. Don't do it, doctor; if you do, your power for good is gone, and you might about as well abandon the treatment at once, for it will afterwards be approached with an apprehensive fear sufficient to destroy much of its potential benefit. All electrical treatment must be gentle—only charlatans need to impress their patients with the enormous power of their machines, or their own immense endurance—physicians need no trickery.

I have known of more than one person in whose case electricity was clearly indicated so thoroughly frightened by receiving a painful shock during the first sitting that they could never be induced to repeat the treatment. That this was due to carelessness and foolish carelessness goes without saying.

It is an exceedingly good plan, one which I never neglect, to test the force of the current about to be used upon the most sensitive spot upon one's own person; the tip of the tongue for example, and if it can be borne there, the patient can bear it anywhere.

So with rule second. Electricity in any and all cases is a tonic—more than that, it is a vitalizer, and vital stimulus not followed by reaction, is what is sought and expected from its use. But, in the use of this powerful agent, caution must be observed not to

over do. If the application be faradic, it is obvious that a too prolonged exercise of muscle fibre will be followed by exhaustion rather than comfortable fatigue, and this exhaustion is likely to be of long duration, since there is no direct antagonistic stimulant known. If it is galvanic, there is still more danger from too large a dose; for the effect of the mysterious action of galvanism upon nerves and nerve centres can neither be measured nor indeed guessed with any degree of probability until days sometimes have passed. And the tire that follows too much of it is mental as well as physical—brain cells have suffered.

I have been more than once struck with the great difference between the practice of our European *confrères* and our own in this respect. Repeated visits to the electrical cliniques of Charcot, Vigoroux, Onimus, Tripier, Benedikt, and Erb, gave as an average of their faradic doses twelve minutes, and of galvanic six. And both Onimus and Vigoroux assured me that they had arrived at this result by careful clinical observation, and were satisfied that more was accomplished by short than by long *séances.* Never tire a patient.

It next becomes our duty to consider the different modes of application of each form of current. There are four ways of using faradism; general, central, direct, and indirect. Faradization, the induced current, electro-magnetism, the volta-faradic current, as it has been variously termed, is the only therapeutical agent known which is capable, when applied to the surface, of producing the most varied sensations, extending from the pleasurable feeling of a slight passing breeze to the most acute pain, either by slow

gradations of tension or by sudden change, without leaving, in the severest applications, any other subsequent trace than slight redness.

It follows that an agent capable of producing such energetic effects as these, besides others of infinitely greater importance to be spoken of in detail further on, must be intelligently employed both in extent and manner, or danger may ensue. I have been able in electricity to discover but two *modi operandi*—one right, the other wrong. There is no middle way—no half-way work which is either satisfactory or safe, and the action of the force is so rapid and decided as to leave no time to correct mistakes.

Let us take into consideration at first, then, general faradization. Beard and Rockwell, in their excellent work, are entitled to more credit than any other authors for placing this form of treatment before the profession; but it was practised in a modified form long before they wrote. There are two methods, the wet and the dry. Human skin unmoistened presents an uncommonly powerful resisting medium to the passage of electricity, and it is therefore better to wet it thoroughly before beginning the application. Have the patient completely undress and put on a loose dressing gown, which will give easy access to all parts of the body without exposure. This had better be made of flannel or some woollen material, for it is difficult to avoid chilling a delicate person whose wet skin is exposed to the air, and a fold of flannel drawn over the surface just finished will prevent the danger. Seat the patient upon a comfortable stool without a back, put his feet into a basin of water at about 100°, place therein any electrode con-

nected with the negative pole of the machine, and attach the positive to a holder carrying a large soft sponge. Place close at hand a bowl of hot water in which a pinch of salt has been dissolved, and begin. Have the sponge just wet enough to avoid dripping upon pressure, bare the patient's shoulders only, and with a current just strong enough not to be painful, sweep the whole surface downward from the base of the skull to the border of the covering garment, not longer than four or five minutes. Dry the parts thoroughly, cover them with a woollen shawl, and proceed to the hips in the same way. The loins need not be uncovered at all, as access is readily had to these regions by causing the patient to stand for a moment. Go on down the legs until the whole surface of the body has been bathed in turn, and every cutaneous nerve stimulated by the current. If this manipulation has been skilfully performed, if care has been taken to maintain the water in the foot-tub at the initial heat and there has been no chill, the result is almost marvellous. New life, fresh vitality has been acquired, and the sensation is that of indescribable bodily vigor, of mental tone, not followed by any reaction. But, of course, one must not expect to obtain this result at first. Considerable practice is necessary in order to learn how to modify current strength by varying the quantity of salt in the water, the pressure exercised upon the sponge, and the quantity of coil in circuit; but nothing short of actual experience can demonstrate that. There are a few things which must be noted. The surface of the body bristles with points which are curiously sensitive to electricity, and these must be attended to

by lessening the pressure of the sponge while passing over them or by skipping them altogether. From the head downward these are the trapezius muscles, the borders of the clavicles, the infra-spinous fossæ of the scapulæ, the nipples, the crests of the ilii and the spines of the tibiæ. Of these the most sensitive are the spots over the points of emergence of the terminal filament of the long sub-scapular nerve, and they must be very carefully avoided, or great and unnecessary suffering will be inflicted. My patients often ask, "Doctor, isn't there danger of catching cold, going out into the air after sitting with the feet in hot water?" My reply is, "No; in all my experience I have never seen any one go away from an electrical treatment and catch cold. There is some powerful but as yet unknown influence exercised upon the nervous system by the current, which enables it to defy ordinary exposures." And I have just dismissed an old lady of delicate organization, who has taken general faradization and other treatment involving the warm-water foot-tub, for five months in all weathers, and walked home afterward without a single cold. If the patient is a person who fancies that hot-water is an unsafe thing, it is better to use a block of warmed soapstone covered with a metal plate, upon which is laid a square of moistened felt. The plate is connected by a screwpost with the negative cord, and water is eliminated. It is difficult, however, to maintain the stone at an even temperature for twenty minutes, and, altogether the first way seems the better. Dry general faradization is more difficult, and is thus practised: seat the patient upon the stool as before, placing under the base of the

spinal column a flat sponge electrode well moistened. Beginning with the shoulders powder the parts thoroughly with good rice flour, or, what is better, with powdered potter's earth as supplied by Pear, of London. With an electrode of polished metal, the penis electrode mentioned in the outfit list does admirably, and using a powerful current, go over the bared surface for five minutes. The electrode must not be permitted to remain stationary a moment, nor must motion be slow, or the patient cannot bear it. But perfect manipulation will come with practice, and the result will be a strong stimulation of skin nerves, a bright erythematous blush, accompanied with a sharp crackling sound as the current forces its way through the obstructing coat of powder. From the shoulders down strokes should be made in rather long sweeps, and so rapidly and lightly as to avoid muscle contraction; the object of this treatment being only that of a general tonic and nerve stimulant. From the feet the direction of strokes should be upward, extending at first to the knee, and thence to the hips, and the result is gratifying. The patient arises from the sitting with skin brightly reddened; *i. e.*, with capillary transit largely increased, with a relief of internal weight and increase of functional activity, which is frequently unattainable in any other way. Erythema soon subsides, but a prickling sensation occasionally persists for hours—showing how large an effect has been obtained. This form may be varied, as indeed may the former, by placing the flat sponge under the recumbent figure at the nates, and proceeding as before. In this way something of massage may be added to

the current, if it is deemed advisable. General treatment by faradization is indicated whenever the operation of any general tonic is desired, having the following advantages over others: it is vital in its action; that is, it operates more or less directly upon the energy which we call life, aiding its potentiality, fortifying its strength, and stimulating its activity. It is harmless in skilful hands. No unfavorable reaction follows its employment, no depression of systemic tone, for there is no *débris* consequent upon its use to be gotten rid of. Acting from the surface through reflex action solely, it reverses the ordinary operation of tonic stimulants, which not infrequently retard the flow of vital force along the nerve trunk by intoxication, which, in some unknown way seriously impairs their conductivity. It equalizes the circulation by relieving internal blood pressure through increased capillary flow, and is thus an excellent remedy for incipient congestion. In this way also, many forms of skin diseases having for origin defective surface change of nutrient fluid, are cured. By varying manipulation electric stimulus may be confined exclusively to the derma without contracting a single muscle, as in the simple dry method, or each muscle of the body may in turn be thoroughly and systematically exercised by using such shaped electrodes and such current strength as may be needed. The fact that even fevers dependent upon a specific germ, such as intermittent and remittent, have been successfully treated in this way, is susceptible of proof, as cases cited later will satisfactorily show. Surface or reflex or general faradization acts especially upon those cells of the posterior horns of the spinal

cord which correspond to those in the anterior horns innervating the surface operated upon; and it is in this way that effects are produced upon parts distant from those under treatment.

Great care must be exercised in the dosage of general faradization as well as in the length of each sitting. The first grand rule—never hurt a patient—is the safest guide here, and the current should be to begin with only so strong as can be plainly felt upon a sensitive point.

One of the best ways of modifying the strength is by means of a water rheostat, either in a tube or in the more convenient form of a wet strip of cloth. If such a strip, say four inches wide and two feet long, be laid upon a table near the instrument, with one end in contact with the water in the foot-tub, the finest possible gradations of current may be made by drawing the free electrode slowly toward the coil along the cloth, and all unpleasant contractions be avoided. Do not give too long sittings. The temptation is strong, when the patient is evidently enjoying every moment of the treatment, to prolong it at his request. But it must be borne in mind that electrical effects are remote as well as near—that the action upon the nerve centres of half an hour's stimulus continues an indefinite time, and in certain cases has a species of cumulative action, and that no amount of practice or experience will enable the doctor to tell just what result he will obtain if the sitting be too long. It happened to me only last week that a lady suffered from neglect of due care in this respect. She insisted on a longer sitting than usual, and prevailed upon my assistant to yield to her

wish. The result was three days in bed with a condition closely resembling hysteria. It is a safe rule never to exceed twenty-five minutes in all, which may be divided by giving ten to the head, shoulders, and arms, five to the trunk, and ten to the legs. In many cases this will be found too long—but the rule will do for a majority.

There is no stage of disease where general faradization may not be cautiously employed. I have practised it in all stages of enteric fever, in pneumonia, and in diphtheria, with excellent sedative effect, and regard its quieting action as far superior to that of drugs. While it has been most generally confined to the convalescing period, I am satisfied that it has a much wider range, and that it only needs that the doctor should make the application *himself* to any form of nervous excitability to obtain good results. But this is usually what he fails to do, and when the inefficient nurse reports that "she tried the battery and it did no good," another instance of the failure of electricity is noted down. As to the difference of polar action, very much has been said upon both sides of the question. For the purposes of this work it is quite sufficient to say that the current direction, in general faradization, is absolutely of no therapeutic importance whatever. It is therefore unnecessary to pay any attention to negative or positive poles, and another source of complication is thus removed. I shall have more to say upon this subject when speaking of special faradization later on.

Regularity in sittings must be rigidly insisted upon. With rare exceptions no person can be charged

—loaded, so to speak—with sufficient electricity to last longer than twenty-four hours; frequently not longer than twelve. I have at present under treatment a case of sciatica, wherein daily applications were just half enough, and twice daily are effecting a cure. The vitalizing influence of one treatment is not strong enough to last two days, and regularity must be insisted upon from the first. I have found the best time for single daily sittings to be toward night—especially so in the case of business men, whose brains are then less actively employed. Nor does a recent meal in the least interfere. On the contrary, digestion and assimilation are both promoted by general faradization, especially by the dry method, and many cases of gastric dyspepsia or gastric torpidity are promptly relieved by the current thus applied. It is better to avoid a time which is likely to be followed by any nerve excitement, such as a party or a business meeting, as this would largely counterbalance both the sedative and tonic influences of the sitting.

As to the length of treatment giving best results, it should be borne in mind that there is a period in electrical treatment where persistence is useless. Up to a certain point, each sitting is followed by improvement more or less marked, and progress toward recovery is steady. Then comes a lull. Although the case does not retrograde, it does not longer advance, and it is evidently time to suspend the applications. For a time, uncertain as to length, the patient remains stationary, finally beginning slowly to lose ground. Then proceedings should be resumed and again carried on until a cure is reached. As an ex-

ample, it may be said that in a case of neurasthenia, accompanied by considerable lessening of vital power, the period of attack will be about three months—of truce, six weeks—and of final assault and cure, two months more. Of course, this is speaking broadly, and each case must be studied by itself—must be treated *de novo*.

CHAPTER IV.

CENTRAL, DIRECT AND INDIRECT FARADIZATION.

At the close of the last chapter I reminded the reader that his instruments must be reliable and well maintained, that is, kept in the highest state of efficiency. If such necessity existed in general faradization, where large and broad applications were to be made in gross, so to speak, it will be found of supreme importance when we enter, as we do now, upon treatment involving fine points of anatomy, of detail. Effects not only unpleasant but positively dangerous have followed the irregular, uneven discharge of an oxidized armature or connection, effects which a small amount of care would have prevented. At the risk, then, of seeming to recapitulate, I wish to impress for the second time the necessity of absolute cleanliness in all parts of the instruments employed. It is better to freshen each opposing metal contact surface with a piece of fine emery paper before the treatment is begun, than to be compelled to stop after one is fairly under way by a sudden cessation of action of the machine. Here surely, forethought is better than afterthought.

Our third chapter begins then, with the consideration of central faradization. The name is, I think, entirely my own when attached to the form of electrical treatment about to be described. By it, I mean

the application of faradism to viscera only, and am aware that the possibility of such concentration of the current as will enable an operator to reach any of the abdominal viscera, for instance, may easily be doubted by an anatomist who remembers the various coverings through which electricity must pass in order to reach its desired goal. But, as the method of directing the current to each organ will be fully described later, in the chapters allotted to diseases of these organs, I have at present only to describe the method at large. Torpid conditions of the liver, spleen, and pancreas may be effectively relieved by directing a strong faradic flow through those organs, their functional activity aroused, and even organic deposits may be removed by increased absorption. In cases of diverted or obstructed biliary secretion, as evidenced by clayey stools, staining of the corneæ and skin, with high-colored urine, no more effective treatment exists than central faradization, administered in the following manner: Place a rectal bulb in position, attached to the negative pole, and with the other connected with a small carbon point, well moistened, work a way gradually between the abdominal muscles in the right hypochondrium, about four inches to the right of the median line, under the border of the right lobe of the liver, where the gall-bladder will be reached—or approximately reached. It is surprising to see how accurately a small electrode may be worked down to the desired point until one tries. Commence with a very slight current, which may be gradually increased until a very strong one is reached; for both the rectum and peritoneum are but sparingly sensitive to

pain, and contraction of abdominal muscles will be almost avoided by the depth to which the electrode has been sunk between them. After fifteen minutes of steady flow, intermit the current by removing one cord-tip from its screw-post and bringing them together again, with a tap at intervals of twenty seconds, for three or four minutes longer. This will, in a large majority of cases—in fact in every one where the obstruction is not a firm impaction—immediately restore the flow of bile in its normal channel, and evidence thereof may be obtained from the next stool. Precisely the same course of treatment may be adopted for the spleen, pancreas, or either end of the stomach. These organs, however, will be alluded to again in their proper places. In central faradization we have one of the most powerful splanchnic stimulants existing—and the safest; for its influence is not followed by depression nor attended by systemic injury. I confidently look for most excellent results in biliary colic from its use, having in one case succeeded in cutting short an attack by the expulsion of a small mass of inspissated bile, promptly relieving the pain. In all the many forms of hindrance to visceral secretion it will be found an effective, safe and welcome substitute for mercury or its numerous vegetable substitutes. There are no instruments necessary for its practice beyond those contained in the original outfit, and no especial skill demanded.

By direct faradization is meant the stimulus by the induced current of a muscle as a whole or in fasciculi, by means of electrodes applied as directly as possible to its surface. It should be borne in mind that the object sought here is restoration of impaired

or destroyed function, not merely a tonic influence. Therefore it is better to act upon as much of the organ at once as is possible, by employing very large sponge electrodes—usually of sufficient size to cover its entire surface. Or a towel may be wetted and laid upon the surface, folded in such a way as to be conveniently reached, with a disk of copper the size of a cent attached to one of the cords and placed within its folds. By thus increasing the surface exposed, a much stronger current may be used than if a smaller instrument were employed, the muscle may be made to contract much more evenly, and scarcely any pain will be felt. Since the object aimed at is restoration of function, of contractility, the loss of which is either the result of central disease or of nerve trunk lesion, a guarded prognosis must be given. Atrophy of single muscles is an exceedingly obstinate disease; and in a number of cases which I have lately treated, improvement has been very slow. Perhaps the best results have been obtained in cases arising from central causes, those following traumatism of a nerve trunk being the most difficult. Great patience is required, and it is rare that less than six months of daily applications is effectual. But when the patient can be persuaded to persevere steadily, and the doctor does not get tired of the case, wonderful results have been obtained. Muscles have been rebuilt from but a single bundle of fibres, and limbs restored which were ghastly in their emaciation. In direct faradization a great difference is noticeable between a slowly interrupted current and one composed of rapid vibrations. In the former case the muscle will bear a tension four or five times as strong as in the latter, the blows being

far enough apart to permit of recovery from the contraction caused by one before the next comes. It is therefore better to use slow interruptions, by disconnecting one cord tip and tapping the screw-post at intervals with it, than to obtain much feebler contractions by a weaker though more continuous current.

The distance apart of electrodes is a matter of very considerable moment. When the object is to influence general nutrition they must be as widely separated as possible; when local effect is desired they must be approximated. It is a safe rule to include within the circuit only the organ under treatment, or if that is out of the question, as little other tissue as may be. In this way the effect is more concentrated, more lasting, and does not influence general systemic tone. Contraction of muscle fibres or bundles should not be mistaken for fibrillar contraction—the former being a firm tightening of the fasciculi stimulated which persists steadily until the circuit is broken, the latter a wavy oscillation of the whole muscle—in which the periods of relaxation and contraction are pretty equally divided, and which resemble the rippling waves of a pond as they come to the shore. The latter phenomenon is regarded as an unmistakable sign of central lesion, and will again be referred to, while the former is just the effect we strive to bring about; and nothing shows more clearly the skill of an electrical operator than to be able to produce at will and instantly all variations of muscle contraction, from the solid hardening of the vasti or abdominalis in a great mass, to the stiffening of a single fibre of the levator palpebræ.

Strength of current must be proportioned to the thickness and conductivity of the tissues desired to penetrate.

If, for example, it be desired to treat the liver in an obese patient, the parietes of whose abdomen are an inch or more thick, the resistance of which is equal to that of many miles of telegraph wire, it is evident that a much stronger current must be employed than where the organ is directly subcutaneous. So with deep layers of muscles, which are occasionally paralyzed while overlying ones remain intact. In these cases all the power that can be borne must be employed; and it is fortunate that the regions of the trunk are comparatively insensitive, with the exceptions before noted. In faradizing the abdomen care should be taken to avoid rapid contractions of broad muscles, or the wave motion thereby induced is occasionally sufficient to arouse a sensitive peritoneum into inflammatory action. This may be done by having one flat sponge electrode under the sacrum and the free hand kept clear of the flanks and centre. If a small sponge point be used, and moved cautiously along the linea alba, or on either side of the rectus muscle, no such contraction will occur.

Direct faradization is the only course advisable in muscular atrophy, either progressive or limited. Of course this does not preclude central galvanism, which will receive proper attention later. When a single muscle is the seat of lack of trophic supply, in my experience it has usually been the deltoid, whose exposed position and the superficial track of whose nerve trunk, the circumflex, seem to mark it especially for injury. During the past month I have had four cases under

treatment, all of which are recovering rapidly under the above form of treatment. My plan is to commence with broad carbon electrodes, one upon the belly of the deltoid, stationary, the other moved over its uncovered surface and over the trapezius. When the inherent irritability of the muscle is aroused, which will usually take ten minutes, I place a narrow sympathetic electrode upon the brachial plexus just above the clavicle, and with a small covered ball cause the entire muscle to contract firmly, *bundle by bundle*. If this cannot be done by a faradic current as strong as can be borne, galvanism is resorted to; if this fails to excite any fibre contraction after two or three careful trials, I abandon the case. But if even a single fibre will visibly respond to either current, there is fair ground for hope, and then steady perseverance is often crowned with success. Before a month the direct faradic current will take the place of the galvanic, a substitution which it is advisable to make at the earliest possible moment, on account of the greater activity of circulation induced by the immense rapidity of polar change in the induction machine, and the consequent greater mechanical exercise of the organ. Unremitting patience is needed in these cases, and not for the patient alone; for I have succeeded in one case in restoring a lost deltoid after two years of steady work. Indeed, nearly all cases needing electro-therapy demand untiring pertinacity and unceasing care for their successful treatment, and none more so than in muscular atrophy.

There is a marked difference in the improvement of impaired muscles when direct faradism is applied as we have described it above, if the nerve trunk sup-

plying it is alone attacked, although the apparent result in contraction may be nearly the same as if the cause were centric. And it is better to work up fibre bundles separately than attempt to affect the muscle as a whole, because it is usual to find degeneration more advanced in some parts of the organ than in others, and those fibres lacking normal nerve stimulus are exactly those needed to reach, which cannot be done through a defective nerve trunk.

By indirect faradization we mean stimulation of an organ through its nerve supply alone, abandoning quite all idea of reaching its substance directly. It will be seen that this is a vastly more difficult and delicate procedure than the former, involving, as it does, most accurate acquaintance with the position and anatomical relations of the nerves of supply of every accessible organ. Many plates have been prepared and published which show correctly the point of entrance into superficial muscles of their nerve-supply trunks, which are the points where indirect faradization must be practised. But to learn them and to retain them in one's memory, is a far greater task than the general practitioner can be expected to undertake. Nor is it necessary in every case. A broad electrode applied across the forearm will contract the flexor longus pollicis as effectively as if a small one were applied over the point of entrance of the nerve, and, in point of fact, I have practically abandoned indirect faradization for several years past, except in rare cases of individual muscle paralysis, like writer's cramp, or as an experiment before anatomical students. Still, there are certain regions which are reached very easily and effectively by this

method, and we will note a few of them. Through the median nerve, in the upper part of its course, we may apply electricity to the internal lower third of the arm muscles, and limit it there, which is an excellent proceeding in a strained biceps, for instance. By means of the crural nerve at the fold of the groin we reach its muscular field by a mild current, which would be otherwise extremely difficult of access, on account of the thickness and bad conductivity of the overlying parts. So with the popliteal nerve and others. There is a notable difference in the excitability of different portions of the same muscle, which is of the greatest importance to remember. For example, in applying indirect faradization to the sterno-mastoid, quite a strong current may be used while the electrode is applied over the point of entrance of the motor nerve about the centre of the belly of the muscle, and the whole organ readily and evenly contracted. But if the carbon approaches the inner edge of the muscle a little below the middle longitudinally, a very violent and sudden twist of the head will instantly follow. So energetic is this contraction of these inner fibres, that I have more than once been afraid of serious consequences following the severe wrench. Most of the broad flat muscles have the same peculiarity, and it is therefore better to use direct faradization, or to maintain the electrode steadily over the point of nerve entrance. The whole face also is exceedingly sensitive, supplied, as it is, with a great quantity of the best fluid conductor known, warm blood, and a correspondingly large number of nerve trunks and branches, and must be very cautiously treated.

The especial points to be avoided are the supra and infra-orbital foramina and the teeth. If any of the latter have been through the dentist's hands and are filled with metal, the approach of an electrode to the nerve trunk supplying them, or to the jaw direct, will probably never be forgotten. So with the lips. There is no reason why either teeth or lips should be subjected to electro-therapy, and they should be religiously avoided. It may be amusing to witness the facial contortions produced by the careless application of faradism to the face, but the fun is entirely on one side, and a disgusted patient on the other. For relief of the stiffness and pain in muscles which is one of the most annoying and difficult sequels of a paralytic attack, there is absolutely nothing that is equal to indirect faradization skilfully administered. When lotions and liniments have totally failed to yield even temporary relief, and they might about as well be rubbed upon a door-post as upon one of these stiff muscles, a steady current of electricity poured into it through its nutrient nerve trunk gives an amount of comfort which must be felt to be appreciated. Fibre bundles soften and relax, a gentle sensation of warmth and renewed vitality creeps through the limb, aching sensory nerves quiet down and rest, and a grateful patient chants loud the doctor's praise. Ten minutes of this is worth ten gallons of liniment. Sometimes very remote effects are noticed from a faradic treatment, which go to establish a fact now well known, that there is no such thing as strictly localized electrization. In the case of a young lady, at present under my care, every precaution must be observed in avoiding central cur-

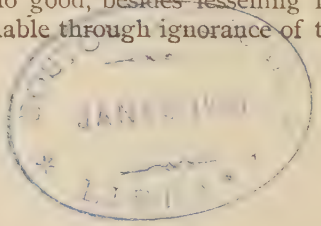
rents, or a uterine hemorrhage is the result. Indeed, the effect of electricity in establishing a menstrual or rather uterine flow, is now so universally understood, that charlatans in large cities are constantly employing it for criminal purposes.

The difference between general and local faradization is that of degree rather than of kind, and can scarcely be better defined than by the above names. When it is desired to affect by stimulus the whole system, adding to its sum total of vitality, enabling it thereby to throw off disease already contracted or resist fresh onsets—when it is intended to quiet general nervous agitation or to procure physiological sleep without the aid of drugs; when the pyrexia of acute inflammation runs high and electricity is summoned to the physician's aid for its reduction—then is general faradization indicated. Nor will it ever fail to meet all calls, if there is no obstacle in the way, such as personal idiosyncracy on the part of the patient or personal incompetency on the part of the doctor. It requires no especial skill for its successful application, only an amount of manual dexterity which may be readily acquired, and an amount of patience which is more difficult to get hold of. Indeed, patience and careful attention to minutiæ, with good instruments, are all the stock in trade needed for this form of electro-therapy. It is almost impossible to do harm in any way while adhering to the rules laid down in a previous article for manipulation, and good can scarcely fail to result. On the other hand direct and indirect faradization need in the highest degree the attention of competent anatomists who have paid especial attention to the nervous system, for

their effective development. They are confined to certain definitely limited fields of action, whose boundaries are invisible to the untrained eye, which must not be transgressed, and have but limited results. It is improbable, from the nature of things, that a general practitioner should ever reach extraordinary skill in this branch of electro-therapy. I once saw my tutor, Duchenne de Boulogne, astonish a circle of the best physicians in Paris by his accurate mapping of separate muscles under faradic electrodes, to such a degree as to call for their loud applause. Several of them took the instruments and attempted to produce similar results, but failed in every instance. The delicacy of manipulation and precision of touch which characterized the master's hand was wanting in theirs, although they were all practised anatomists. Happily, such exactness is unnecessary in the vast majority of cases, and most excellent results are often obtained by charlatans who are totally ignorant of anatomy, but who have learned practically the best way to make electrical applications.

Prominent among the causes of failure in results are imperfect instruments, the use of one current when another is indicated, incorrect manipulation and lack of patience. We need no longer consider the first of these—they may be taken out of the category, for we are assuming that our readers have provided themselves with proper appliances. The second is a far more difficult one and requires much consideration. For the purposes of this work it is not practicable to devote much time to consideration of the recondite reasons which influence an expert in choosing one or the other form of treatment for such or such a case,

and it will probably suffice to say broadly that faradization is indicated when reflex, peripheral, general tonic or localized muscle effects are sought; galvanization, when it is desired to influence the great nerve centres, to stimulate the vaso-motor tract, or to perform electro-surgical operations. Incorrect or careless manipulation can readily be avoided, when the proper methods have been learned and when there is no necessity to hurry. In subsequent chapters, careful and minute directions will be presented in detail. Lack of patience, which is synonymous with lack of time in most cases, works infinite harm. Persons suffering with intensely irritable nervous systems need slow, deliberate movements on the part of their attendants. A fidgety nurse or a doctor in a hurry should avoid the use of electricity in any form. Quiet rooms, comfortable surroundings and plenty of time, prepare a patient for treatment as they only can, and it is doubtful if any good was ever attained from electrical treatment unless they can be insured. True, the general practitioner, accustomed to a rapid round of fifteen-minute visits, will find this statement inhibitory, and it is intended that he should, for it is better to avoid doing harm than to make futile attempts to do good, besides lessening faith in what is really valuable through ignorance of technique.



CHAPTER V.

THE TECHNIQUE OF GALVANISM.

A GENERAL consideration of the use of galvanism in medicine will next occupy our attention. The many essential points of difference between this form of electricity and faradism, the necessity for greatly increased caution in its use, and the wide range of its effective value demand that considerable space be devoted to its study. It has received a variety of names at different times from different writers, but the terms used are such as will by no means tend to confuse, as in some way they all express the same meaning. Among them are the constant, the continuous, the voltaic, the galvanic, and the direct currents. The two first apply to the steady flow of the stream, the next two to distinguished discoverers of most of its qualities in medicine, and the last to the fact of its arriving direct from the cells or battery without intervention of a coil. For our practical purposes, however, it will be sufficient to term it galvanism, in contradistinction to faradism, its allotropic relative. Indeed, one of the chief stumbling blocks in the way of a quick and accurate conception of electric medical treatment has been the multiplication of technical terms which mean the same thing and are indifferently used by the same authors. Conciseness is a quality which is difficult to obtain in the

phraseology of a comparatively new branch of scientific study, when each worker must use his own terms to describe his results since no authoritative standard yet exists, and it shall be my endeavor to restrict the use of such terms as are requisite to express the implied meaning to as small a number as possible.

For general work the two varieties of battery described in the first chapter will prove amply sufficient, viz., the 24-Grenet cell portable and the 30-cell office, or permanent instrument. Since they have been fully described before, no further allusion to their arrangement need be made here. Unlike a faradic machine, which deteriorates but slowly, and which will produce about the same effect as long as part of the battery force remains to animate the coil, a galvanic battery requires most assiduous care and constant attention if its usefulness or value is to be depended upon. For, from the moment of its beginning to act, it commences to lose electro-motive force, and in the case of the Grenet battery, or of any other form of intense energy, with great rapidity. It is therefore absolutely necessary to test a battery each time it is to be used, so as to be approximately sure of the dosage to be employed. For this purpose no galvanometer or other complicated instrument is needed, the operator's own sensations being sufficient. A current which is to be employed about the head or upper part of the spinal cord should be derived from only as many cells and be strong enough to produce a slight glimmer of light when one pole is held in the hand and the other tapped gently upon the orbital ridge, or a coppery taste in the mouth when the

latter pole is pressed firmly for a moment upon the cheek. When deep nerve trunks or the spinal cord below the cervical portion are to be treated, the number of cells should be increased until the current slightly burns the skin (in sensation only), and an erythematous blush is produced after a moment or two of steady application of the electrode to the skin over those parts. For the former effect not more than two or four freshly charged cells will be needed, for the latter either six or eight. Fluid in Grenet cells should be removed after each day's use if possible, since its retention therein will soon result in the formation of crystals of chrome-alum, which, being very slightly soluble in water, are difficult to remove and worse than useless if allowed to remain. I am of course aware that this will involve considerable trouble, but there is no other way in which a portable galvanic battery of Grenet cells, infrequently used, can be maintained in a state of efficiency.

Great care must be taken in the employment of this form of electricity to cause no shocks. If they are avoided, and there is never any necessity that they should be produced except when indicated and called for, there are no muscle contractions, no flashes of light, no unpleasant metallic taste nor giddiness to be feared. Shocks may be produced in three ways: by applying the electrodes and closing the circuit with a number of cells to begin with, by removing one or both electrodes without diminishing the number of cells, and by suddenly reversing the direction of the flow. Now, there is no reason why any operator should not possess enough skill in manipulation to avoid these rocks in his path; and it is more fre-

quently carelessness than ignorance that neglects precautions. In using galvanism, begin then with the cell selector, the sliding-bar to which the cords are attached, the galvano-meter at zero, or the switch-arm on the office battery pointing to the lowest number, place the electrodes in position, and increase slowly, cell by cell, or pair by pair, until an effect is plainly perceptible by the patient. When the sitting is done, retreat in the same cautious way and there will be no trouble. Never remove electrodes from the skin when moving them about as in spinal cord applications. When at the end of the downward sweep press firmly for a moment upon the sacrum, and move the sponge upwards.

Under certain circumstances the shock of closing the circuit or of application of the electrodes is the strongest, in others that of opening. In any case and always, it is to be feared and avoided. Sudden reversals of current direction, caused by turning the switch placed for that purpose upon the key-board of the battery, are productive of very severe and painful effects. In certain paretic cases these shocks, voltaic alternatives as they are termed, are exceedingly useful and necessary. But I find it better to explain to my patients that they are about to receive a blow and thus prepare them for it, than to inflict one unawares and so startle them. If it is wished to change current direction in ordinary treatment, it must be done only after reducing the number of cells in circuit to zero ; and it should be borne in mind that after such change, it will not be proper to use the same force as previously. Flowing in a different direction, it causes a reversal of polarity in nerve cells,

at first characterized by a greater sensibility, but which disappears as soon as they have grown accustomed to the change, when the number of elements may again be increased up to the dosage point. Always commence with low force. Only a tyro, it would seem, would begin with a larger dose than could be maintained; and yet it is too frequently done not to be alluded to in a work like this. If the desired effect can be attained without any unpleasant sensation whatever on the part of the patient, so much the better, and this may often be done in cases of insomnia, or the general nervous excitement of neurasthenia. With galvanism, great care in the direction of the current—in locating the battery poles—must be exercised. I have previously stated my conviction that in faradism this caution is quite unnecessary, that it makes no therapeutical difference whether the positive pole be above or below. Not so with galvanism. Besides the well-known vitalizing results to be expected from galvanic treatment, there occurs in the track of the current between the two poles a certain amount of electrolysis—of decomposition. And, as in surgical electrolysis, acids are collected at the positive needle and the alkalies at the negative, so in this curious internal process, which is so complicated by factors difficult to formulate as to be well nigh incomprehensible, it is safe to conclude that a radical difference in result must attend the application of one or the other pole. And experience steps in promptly to confirm our theoretical reasoning. A single trial of the ascending current in a case of cerebral excitement will convince the most prejudiced observer that it is useless for good, and the

prompt quietude and drowsiness that comes when the current direction is reversed, is more potent to convince than pages of theory. One of the most frequent results obtained from the application of galvanism, even to parts distant from the centres, is this same quieting of nervous excitement, followed by a sweet, sound sleep. One of my patients, a lady of exceptionally fine nervous organization—so fine, indeed, as to be occasionally aggravating, and who will go a week without rest with no perceptible bad effect and then quite collapse—is an excellent example of this wonderful effect of galvanism. No matter how excited she may be, even to the verge of hysteria, after a ten minutes' sitting drowsiness comes on, relaxation of tension follows, and she will sleep quietly until roused, and awake refreshed and serene. There is no known drug that can produce such an effect; and all this, far more than this, depends upon the current direction. I believe that by a proper application of galvanism to the cervical vaso-motor ganglia, alternate contraction and relaxation of blood-vessels may be produced at will, as the positive or negative pole is employed. This has been repeatedly verified, both by myself and others, by observing with the ophthalmoscope retinal arteries alternately dilate and contract, as current direction was changed.

Nor is it at centres alone that this difference is perceptible. In cases of sciatic neuralgia, where prompt relief of pain usually follows application of a descending galvanic current, no good result follows the reversed flow. On the contrary, the paroxysm is frequently increased in gravity, and I am persuaded that a large percentage of failures of electrical

treatment has resulted from this very cause—neglect of current direction in galvanic applications. Where does the galvanic current go, and what does it do are questions which are asked by almost every inquiring physician who is looking up the subject. Where it goes is easy to say; for nothing is more susceptible of proof than that galvanism will pursue its course from pole to pole of the battery in the most direct line possible, irrespective of such obstacles as the human body presents. This may be readily demonstrated in a rough way by holding the positive pole in one hand and touching the eye, cheek, and mastoid process in succession with the other, when a flash, a metallic taste and a sense of dizziness will be produced, as the several cranial nerves are stimulated. Where it goes, then, we can safely say; but to deduce from this the assertion that it confines itself strictly to the direct track from pole to pole, is unsupported by experience or experiment. Nor is it practically a matter of consequence. When we know that a current sent transversely through the cranium will produce dizziness and that the same strength directed in an antero-postero direction in the median line will not, we have learned all that our purposes require, and may dismiss the consideration of theories. What does it do? If it were possible to give a concise answer to this question, it would be easy to solve problems which are still impracticable, and even the veil of the infinite might be lifted, so close is the apparent relation between electricity and the *vis vitæ*. Only a very few of its phenomena have so far been noticed and formulated—and what it does *not* do is scarcely more unknown than what it does. Its gen-

eral effects have already been hinted at and will be carefully considered further on, as well as its more circumscribed action. It is certain, however, that all efforts to restrain fully its remote action—that is, the subsequent results of treatment, are so far futile. Only a careful study of each case in the light of actual experiment can satisfy one of the possible good to be obtained. Central applications have brought about menstrual flow and galvanization of the sciatic has been followed by a profuse diarrhœa. But these are exceptional cases, and only used to illustrate the difficulty of answering the question, "What does the current do?" A much more profound systemic effect follows the use of galvanism than of faradism. This was of course to be expected, and yet is scarcely appreciated by the general profession, who are too apt to employ the currents indiscriminately and then wonder at specialists who write of wonderful results which their own instruments and labor never produce. So widespreading, indeed, in its effect upon the economy is the central use of galvanism, that great care must be employed in the initial dosage. A young lady sent me by Dr. Crosby, of New Hampshire, for a suspected cerebral tumor, began treatment with six minutes of sympathetic galvanism with six Daniel elements, and the vomiting which ensued was only stopped after hours of careful labor. Usually, however, systemic impressions are beneficial, and continued lead toward cure. In using galvanism avoid all places where the skin is broken. Passage of an electrode over even a pin-scratch is attended with sharp pain, like molten metal falling on the skin. After the erythematous blush appears

which follows a few moments' application, it is better to move the electrode than to run the risk of getting up a galvanic burn and ulcer. For nothing in the way of a solution of continuity of the skin is so difficult to heal as one of these ulcers, and the resultant scar is indelible. Look carefully that all tips of cords or other metallic points are thoroughly covered, as a bare surface will destroy the skin beneath, while the current may not be strong enough to be more than pleasantly tangible. The negative pole has more chemical action, the positive more calorific, and it is well to remember this distinction, particularly in spinal cord applications, as the skin on the lower part of the back is rather insensitive, and therefore liable to be burned without the patient's knowledge.

Good effects are obtained in a course of galvanic treatment by alternating it occasionally with faradism. The nerve centres gain rest from direct stimulation, and seem to be refreshed by the induced current, taking hold of the constant with renewed zest and an increase of assimilation. For it is certain that no part of the subtle fluid that is set in motion by a galvanic battery and directed through the human frame by human intelligence, ever remains within the economy. In passing through it simply sets atoms in motion, starts into activity the electrical fluid already there—already pervading everything—and impresses each organ with some of its own restless, tireless industry. Glands that have been torpid rouse into life at the presence of the new stimulant and again exercise their normal functions with regularity. Absorbents whose mouths have long been clogged by lack of vital tone, awake and start to their

work with renewed vigor, as the magic presence of the new life makes itself felt, scattering right and left inimical forces that beset them. Brain cells develop thought more freely as *débris* of retarded circulation is cleared away by increased flow through cerebral vessels, and fetters that weigh heavily upon golden fancy are struck from the sensorium with the light tap that closes the galvanic circuit through the head, or, applied to the cervical sympathetic ganglia, opens wide the way for the exit of effete matter. Nerve trunks, whose rigid sheaths make each inflammatory enlargement a confining source of agony, are emptied of blood supply by the same process, and, resuming their normal dimensions, quiet down to soothed rest. Insomnia vanishes like a dream before the conqueror, and sweet, normal sleep brings health upon its wings to the tired sufferer. The wonderful effect previously spoken of as "vitalizing" for want of a better word, soon follows regular, skilful galvanic treatment. Flowers are sweeter, stars shine brighter, and all the loveliness of life so quickly banished by nervous disease returns to bless the thankful convalescent. Nor is this any fanciful sketch. No words of mine are strong enough, eloquent enough to interpret or express one-tenth the thankfulness—one iota of the content which shines in the eyes of a patient whose nerves have been restored from a condition of furious irritability to approximate quiet, and whose tongue is quite unable to express what he feels. It is like a weary traveller by sea, who, tortured day after day by the terrible demon of seasickness, suddenly finds the ship still and at rest in port, and gives fervent thanks to God that he is once more on firm land.

Applications of the galvanic current may be classed as general, central, and local. The employment of general galvanization does not materially differ from that of general faradization in technique. It is better in giving a sitting of this kind to use carbon or metal electrodes covered with wash-leather, as the ordinary faradic sponges do not permit close enough approach to the skin. In passing *down* the trunk and *up* the limbs, following in the main the blood circulation, it is wise to follow also the nerve trunks—the brachial and axillary plexus branches in the arm, the sciatic, crural, and popliteal in the leg. Follow precisely the same directions in preparing the patient for this as for faradism, and commence in the same way, avoiding the head, neck, and spinal column. Sweep the trunk steadily downward with slow motions, never raising the electrode from the skin without first reducing gradually the number of cells to the starting-point, zero. As a rule, eight Grenet or fourteen Flemming cells, equivalent to two to three milliamperes, will be quite sufficient for a maximum, which, however, must never, under any circumstances, be painful. When the redness which indicates capillary filling has been produced it is sufficient, and the next part is reached in turn. The total length of a treatment should never exceed twenty minutes, and rarely fifteen. This is a rule which should be more rigidly adhered to in galvanism than in faradism, since secondary systemic effects are more extended and of more cumulative nature here than there. Nor are daily applications so necessary. I am in the habit of commencing a course with two sittings a week, increased after the first month to three, and after the

second to four or five. An occasional day of rest is advisable, as it permits a survey of progress. As a general tonic general galvanism is inferior to the other form, and is better adapted to conditions of profound vital depression than to those of simple functional lack of tone. Alternately used, say faradism a week and galvanism two days, the combined result is frequently most happy.

Central galvanization is next to be considered. It is indicated whenever the central nervous system is at fault, in most central lesions, in general paresis, in certain skin diseases, and in general neuralgia. My lamented friend, Dr. Beard, together with his associate, Dr. Rockwell, have done far more than any other or all other living authorities to describe, illustrate, and popularize this form of electro-therapeutics, and the credit of having done so belongs to them exclusively. Still, the method did not originate with them, having been employed by Duchenne and others before them, and by myself at about the same time.

Its application and use may be extended to all the nerve centres, or may be restricted to the cerebrum and medulla, sympathetic ganglia, or spinal cord. As a rule, it is better to go over the whole ground, but in cases of cord disease or of nervous dyspepsia it is unnecessary. Have the patient stripped to the waist and covered with a loose garment, which will give ready access to all parts of the trunk, provide three electrodes, one large and one small carbon, and one sympathetic bar, and with a bowl of warm salt water, all is ready. Saturate the hair on top of the head thoroughly, avoiding unnecessary excess of water, and place the large carbon, well moistened and at-

tache to the negative pole, in position there. Place a smaller one also wetted, over the solar plexus, and switch on the circuit, beginning with a single cell. Wait a moment, and slowly add another and another, until the galvanic taste, that of copper, is plainly perceptible. It is then quite strong enough. Allow the current to pass five minutes, switch back again slowly, and remove negative electrode, which is to be placed over the cerebro-spinal axis, and the circuit again augmented until a distinct warmth is perceived at the epigastrium—which sensation may require twenty cells to produce. As soon as it is noticed, reduce the battery to not more than two milliamperes, or four cells, and hold steadily for five minutes, gradually reducing to zero. Retain the negative carbon in position, and substitute the sympathetic bar for the positive button. Press the bar, well moistened, into the groove behind the sterno-mastoid an inch below the lobe of the ear, when it will be about over the middle cervical ganglion of the sympathetic, and switch on battery, cell by cell. Utmost care is now imperatively demanded, as the sudden constriction of cerebral vessels frequently causes violent giddiness and occasional syncope. It is better to wait a few seconds after each added cell, and to stop as soon as the patient experiences either dizziness or nausea. Forty seconds is long enough here, when the bar may be removed without switching down, by moving it slowly down the back until the resistance is greater than the electro-motive force, when it may be removed without any shock. Repeat the proceeding upon the other side of the neck, noting carefully any difference between the two. By this

time the skin under the negative carbon is quite red, and it should be moved downward a few inches. Retain it there, and place the positive, again attached to the carbon button, upon the sacrum, moving thence slowly and steadily up and down over the spinous processes, avoiding too close proximity to the other pole. Give five minutes here and the sitting is done. Without waiting to dress, wrap a shawl or afghan around the patient, and have him lie quietly down for a few minutes, when he will usually be found asleep. As previously stated, any part of this method may be employed to the exclusion of the others, or all may be combined. For sedative purposes I have obtained the best results with the spinal-solar current, and in neuralgias with the sympathetic. A few seconds of trial will usually show plainly the best method in any given case. In this central form I have discarded every battery except low tension ones like Daniells or Leclander. The ordinary blue vitriol cell used in telegraph offices is as good as any, and I regard the sharp, harsh force set in motion by a Grenet series as positively injurious to nerve centres.

Local galvanism is restricted in its employment to the discussion of tumors, treatment of local neuralgias, and of such muscular paralyses as fail to respond in contraction to the induced current. There is nothing in its technique which differs from local faradism in essential particulars, and its application will be described in the treatment of cases further along.

It only remains to call attention to one or two points in the employment of this powerful agent. As with everything else, idiosyncracies must be con-

sulted. Some few persons are so exquisitely sensitive to the diffused presence of the fluid, as to be able to discern a metallic taste when near a person through whom a powerful galvanic current was passing. I have never been able to satisfy myself positively of any such phenomenal acuteness, but am strongly inclined to believe in its existence. Others, and women do not comprise any more than their share of this class, will faint when the current from two or three Flemming cells traverses their heads. Never give such a patient a second dose, using faradism instead, which is harmless. The cause of such hyper-sensitiveness is as yet quite unknown, and it can only be regarded as a danger-signal; go no further in that direction. The great value of galvanism in skin diseases of a nervous origin is now undisputed, and I have obtained exceedingly good results in some cases of urticaria, using central galvanization alone.

Enough has now been said to introduce the reader fairly into the consideration of special cases, and electrical treatment of special diseases, which will accordingly be entered upon in the next chapter.

CHAPTER VI.

DISORDERS OF SPECIAL SENSE.

In the consideration of electro-therapy from a practical standpoint, it has occurred to me that a classification of diseases with their treatment would be more ready for reference if it was arranged with a view to the relative frequency with which disease types present themselves for treatment. Upon reference to my case books, I find that a majority of new cases are entered under the head of "Disorders of Special Sense," then neurasthenia, the gastric variety leading, then functional insomnia, and so on. As it is tolerably certain that what happens here will happen throughout the Northern and Western States at least, I have made my arrangement of disease names consonant therewith, and will be governed thereby in precedence of consideration.

By far the greater number of cases coming into a specialist's hands for electrical treatment are those of disorder of special sense, either functional or structural, and are usually dependent upon some affection of the digestive apparatus or abuse of sexual proclivities, or are warning symptoms of cerebral lesion or actual accompaniments of its presence. In functional cases excellent results are usually obtained, from electrical treatment, but peripheral disorders of

central disease are slow to respond, and are generally incurable. In all such cases the outcome must depend upon removal of cause, and prognosis must be very guarded. When, on the contrary, it is decided that deranged sense is only suffering from participation in a distant storm, it is generally safe to promise a speedy cure.

Of disorders of the sense of touch, local anæsthesia is most common, and is usually the result of pressure upon a nerve trunk or of exposure to cold. When the entire surface of one-half the body is affected the cause is central; when isolated patches only appear, changing their degree of sensibility from day to day, an excentric origin is indicated. In either case faradism is to be used, bearing in mind that the use of no current of electricity is safe or advisable during active stages of brain or spinal cord disease. In treating for anæsthesia, if the patch is small, place a large flat sponge electrode upon or under an indifferent point, and stroke the part with the wire brush. As very high electro-motive force may be applied to these patches without sensation, a large sponge must be used at one pole to diffuse the otherwise painful current. Continue the application ten minutes, when the patch should be bright red; if not, for twenty minutes in all.

Case I. May, 1883.—Mr. W. O. A., a powerful, healthy man, aged forty-four, woollen goods manufacturer. No hereditary diathesis. Five years before, had been thrown from a stage coach and suffered severe concussion generally, but quite recovered. Has been accustomed to spend several hours each day in different rooms of his mills. Ten months

previously, felt severe occasional pains in right hip and thigh, lasting twenty-four hours, and only disappearing after hypodermic morphia. Ten days afterward a numb patch appeared upon right thigh, which disappeared shortly afterward. A month later, while in Boston, the same sensation returned, lasting half the day, again disappearing. Six weeks ago after lifting a heavy weight, the numb sensation reappeared, rapidly spreading over the whole of the outside half of right leg. Line of separation from normal skin well marked and anæsthesia complete. Motor reaction to faradism increased. Powerful faradic treatment repeated daily with the wire brush and entire absence from the mill, effected a cure in five weeks. Up to present date, April, 1884, there has been no return. I regarded the case as one of mill concussion of the cord, a condition arising from the continuous vibration of mill floors to which mill operatives are constantly subject, and with which practitioners in manufacturing towns are familiar.

Case II.—Miss Mary B., a slight brunette aged twenty, worker on plate jewelry, came to my rooms on the 10th of June, 1883, with an anæsthetic patch some three inches square on the left side of the face. The night before, she had driven six miles with left face exposed to a strong cool breeze, and awoke in the morning feeling it "all numb." Otherwise healthy, no loss of motion, but sensation so completely abolished that a needle plunged into the space was unnoticed. Three applications of an exceedingly fine faradic current completely removed the difficulty, which has not since recurred. The wire brush should

not be used about the face, as the high tension of a powerful faradic current sent through fine wire will readily cut through the delicate skin of a lady and leave ugly scars. A small carbon point well covered is safer and equally effective.

Next to anæsthesia, aphonia is most frequently met with in my practice. It is usually partial, nearly always functional, and yields quickly to well-directed faradism. Sometimes surprising results are attained in long standing cases which have resisted all other treatment—results which go farther to establish the reputation of a physician in a few moments than years of painstaking work in the regular way. It is necessary carefully to distinguish between aphonia, speech lesion, and aphasia—between loss of voice and loss of ideas for the voice to vocalize. There is rarely any difficulty in this, for even if the usual marked symptoms of central lesion which accompany aphasia should be masked or absent, a laryngoscopic glance at the vocal cords during an attempt at phonation will immediately decide. If, while the mirror is in position, a prolonged "ah" is slowly uttered, followed by a short "eh," the cords will be seen to approximate, close the chink and suddenly relax, opening wide. Practically, if they are motionless, the difficulty is aphasic; if slowly and imperfectly responsive to the nerve demand, aphonic. The same inspection will show the presence or absence of any tumor or other mechanical obstruction to phonation. There are two stages in electrical treatment of this disease, external and internal, both of which are needed in most cases. Have the patient's throat bared to the clavicles, and pass

for ten minutes a fine faradic current from a large sponge electrode placed just above the vertebra prominens to a carbon point in the supra sternal fossa. It should be of sufficient strength to be felt distinctly through the neck as a sense of constriction, not pain. Changing the sponge for a smaller carbon button, pass the same current through from side to side of the larynx for five minutes. Then place the flat sponge electrode at the back of the neck, and passing a laryngeal electrode rapidly down to the vocal cords, close the circuit, either by the spring attached to the electrode, or if the impromptu one which I shall describe be used, by having an assistant tap the battery screw post with a released cord tip. The result is a quick contraction of the relaxed cords, with increase of functional power, and occasionally an instant cure of the disease. The best laryngeal electrode is Mackenzie's, with my button current closer in place of the old spring. If that is not at hand, take an olive-tipped bougie, number 11 English scale, draw over it a flexible rubber catheter or bit of fine rubber tubing, leaving the tip and handle bare. Give it the usual prostatic curve, and with a wire twisted around the handle it will do very well. In passing down to the cords, follow the surface of the tongue with the metal, and so avoid irritating the sensitive pharynx. The current must only traverse the cords in shocks—never be sustained—and only half a dozen good contractions procured at a sitting, especially when the difficulty is of long standing. If a cure is not obtained in six or seven applications, local treatment should be abandoned until after a course of general tonic faradization.

CASE.—Mrs. H., an anæmic woman aged about sixty, came to me in 1878 from Danielsonville, Conn., having been voiceless for eleven months. Utmost efforts could only produce a hoarse whisper unintelligible three yards away. Her son who accompanied her, told me that the disappearance of voice was sudden, following a severe cold, and that all efforts to restore it had so far been vain. Electricity had been applied in the usual external way without success. There were no cerebral symptoms, or, indeed, symptoms of any disturbance except aphonia. Upon inspection, the cords were a pale yellowish white, normal in position and vibrating slightly under phonic stimulus. Omitting external application, I placed the laryngeal electrode in position with a large sponge at the back of the neck, and closed circuit twice with a strong faradic current. Instantly she screamed "Ow!" loud enough to be heard across the room, and voice was restored. When she found that she could actually speak again, her joy was almost frantic. She shouted, sang, and prayed until exhausted, in spite of orders to be quiet. I directed her to return the next morning for a second application, but none was needed. Her voice had returned to stay, and, two years afterward, she came in to show me how well she was.

Anosmia, loss of the sense of smell, is comparatively rare. I have seen but two cases which were uncomplicated with cerebral lesions so far as could be determined, and in both of these considerable benefit followed employment of galvanism. A nasal electrode, made by tying a bit of wet sponge upon a piece of stiff wire insulated by rubber tubing, should

be introduced into each nostril in succession, and connected with the negative pole of a low tension galvanic battery, the positive being held in the hand or placed upon some indifferent point at about the same distance away, so as to insure sufficient resistance. From zero run the switch bar slowly up until a distinct sensation of heat is felt in the nose, which will require three or four cells. After two minutes reduce current strength until it is not perceptible, and sharply reverse poles. Repeat the proceeding three or four times and enough has been done for once. If, after a reasonable length of time, say ten daily sittings, no benefit is experienced, it is improbable that longer treatment will be of use. Favorable symptoms are a faint perception of the usual galvanic taste, and a slight sense of the odor of onions. Taste is abolished when smell is, as a rule, branches of the same nerve supplying both impressions, and the same treatment suffices for both with the addition of two or three minutes application to the tongue. Recovery is usually imperfect at best, and it is difficult to persuade a patient to continue who is otherwise in good health.

CASE.—Mrs. S., a wealthy widow of fifty years of age, portly and in excellent general health, came to me for treatment in 1880, with complete abolition of sense of smell, and nearly total loss of taste. She could with difficulty distinguish between strong vinegar and lime-water, not at all between salt and sugar. This loss of function had gradually developed after the loss of her husband and severe nervous prostration following the same. Treatment was commenced upon the above plan, and followed for six days, when

she could plainly tell salt from sugar, and faintly distinguish acids. A cut onion held to her nose, the eyes being covered, was unnoticed. After ten days more taste had returned to the degree that she was again able to enjoy her food, but the sense of smell remained lost. Two months treatment restored taste completely, but smell was but slightly improved and the case was abandoned. At the present writing Mrs. S. can only perceive the strongest odors with difficulty, although taste is perfect, and she is in excellent health.

Diseases of the eye which are amenable to electro-therapy are those of nervous origin, and loss of motor supply to muscles of the eyeball and lids. Among these my best results have been obtained in nervous or tobacco amaurosis, congestion and anemia of the optic nerve, congestion and anemia of the retina and loss of control of muscles. Two cases of incipient cataract and three of corneal ulcer have been cured as well as several of photophobia. Several cases of color blindness have been unsuccessfully treated. In nervous amaurosis it is better to use general galvanization and local applications conjointly as follows: After the usual central application has been made, transfer the cord tips to a faradic machine, place a large sponge electrode well moistened and connected with one pole within easy reach upon a table, and attach the other to an electric eye-cup filled with warm salt water, which is preferable to a sponge or the hand, as it diffuses the current equally over the ball. Using a moderately strong and very fine current, rest the patient's hand upon the table close to the sponge. Bring the two into

contact—one finger at a time, until the current is felt as a gentle sensation of warmth in the eye without prickling. Continue the flow for four minutes and break contact in the same cautious way. All shocks, flashes, etc., will thus be avoided, and the whole organ thoroughly stimulated. There are few cases of nervous or tobacco amaurosis which will not yield to ten or twelve days of this treatment, provided of course, that total abstinence from tobacco be enforced. Congestion and anemia of the optic nerve or of the retina are marked by a blurred vision, dancing fire balls or sparks and easy visual fatigue. Only the ophthalmoscope can determine between the two conditions, and galvanism will be found more effective in congestion as faradism is in anemia. Precisely the same mode of application applies here as in amaurosis, only the length of time should be at least doubled. Most excellent results have followed in a majority of cases, and none have gone away without improvement. In the earliest stages of cataract, when the lens was beginning to be clouded from structural change, cures have been effected in two cases. Here it is necessary to localize galvanism as nearly as possible through the lens. Let the patient hold the positive pole of a low tension galvanic battery in either hand, while the operator, steadying the ball with his left, applies directly over its centre outside the lid a fine carbon point or metal ball the size of a pea, covered with moistened wash leather. By the law expressed in the first chapter the current following its shortest course from pole to pole will traverse the lens, and, stimulating its lining membrane, cause dispersion or absorption of the cata-

ract. Patience and much care are needed in applications such as this—for at least four months daily sittings have been required in my cases, and the delicate skin of the lids must be protected from injury so as not to interrupt treatment. Brilliant results may be obtained in all cases of muscular insufficiency about the eyeball excepting those dependent upon central lesion. Functional paralysis of either of the recti or oblique muscles, or of the levator palpebræ, is exceedingly common as the result of exposure to cold, or in the course of an attack of nervous exhaustion, and electrical treatment is thus applied. Using an exceedingly fine faradic current, passed through the water moderator or rheostat previously described, so as to grade current strength by steady advance, place a large carbon point over the occipital protuberance, taking care to moisten the hair thoroughly. This may best be held in position by an elastic band of hard rubber, or by the ordinary laryngeal headband. The operator, with one hand upon the patient, should place the other upon the moderator, so wide open that he cannot feel the current at all, and gradually close it until his own palmar and forearm muscles are contracted. Then, with the tip of the forefinger of the hand which was touching the patient, slow passes should be made over the lids, causing each fibre of the levator to contract in turn until the whole muscle is well exercised. In treating the recti, or oblique muscles, localize the current in the same manner as closely as possible over the attachments of those muscles and permit it to flow for fifteen minutes. If it is effectively done, the eye will slowly rotate to its normal position and retain after

each sitting, something of the ground gained. Three or four weeks have been sufficient to cure the worst of my cases.

CASE I.—Mr. R. F., of Mobile, Alabama, aged forty-two, unmarried, cotton broker, consulted me in the summer of 1882 for well-marked functional amaurosis. In addition to the usual symptoms he had severe diplopia, with double divergent squint. For several years had been in the habit of writing much at night, as his business required him to be on the street during the day. Was considerably addicted to sexual pleasures, rarely passing a night alone. Otherwise in fair health, with the exception of occasional attacks of malaria. Treatment was commenced with general faradization for a week as a general nerve tonic, and continued locally for four weeks with the best result. No recurrence until the next year, when a relapse occurred from a repetition of former causes, and I have been unable to learn his present condition, as he has not been North since.

CASE II.—Mrs. F. C. G., of Boston, from the care of the late Dr. Clapp, of Pawtucket. Married, aged thirty, feeble and anemic. About six weeks previously patient detected a misty cloud before her eyes which considerably interfered with vision. Consulting Dr. Clapp, an incipient cataract was diagnosed, and as the result of a conversation with me a week before upon the subject, he recommended a trial of electricity. Treatment was begun with galvanism applied as above directed, alternated with general faradization as a tonic. In ten days cloudy vision began to clear up, and the lens to assume a greater transparency. Improvement was very slow, but de-

cided, and was regularly continued for five months, when no trace of opacity remained, and sight was stronger than ever before. In these cases the main difficulty lies in persuading patients to be patient: to continue the treatment for a sufficient time when progress is slow.

Case III.—G. F. S., a physician, in excellent general health, consulted me for a ptosis of the right eyelid, which developed slowly after several months of close evening study and frequent severe exposure to cold while driving. He was also slightly myopic. The levator muscle was regularly faradized for two weeks, general applications of the same current to the ball being made by the electric eye-cup for the same length of time. He was then obliged to stop treatment by absence from the city, but the ptosis had very much improved, and the myopia also.

I have at present under charge a gentleman who has single external squint together with ptosis of the left eye, and excellent progress is being made in his case.

Affections of hearing, due to hysterical and functional disturbances of the auditory nerve, are comparatively common and are usually readily cured by electricity. Those having for origin structural change in the nerve, or which come of central disturbance, are best let alone, as well as those cases where inflammatory disease of the inner ear is present. Malingering deafness is readily detected by using a powerful faradic current to the external ear, and saying in an ordinary tone of voice, when the sensation is quite painful, "I must double the strength soon, and shall do it very suddenly, so as to give a severe shock

to the nerve." It will probably be difficult to find a malingerer who will fail to hear under such stimulus. Before attempting electrical treatment, it is always best to examine carefully the meatus externus, as I have seen two cases of deafness which were referred to me as nerve lesions, where the canal was firmly and completely closed with a plug of hardened cerumen. Supposing nothing of this kind present, treatment to the ear is commenced as follows: With the patient comfortably lying upon the sound side, fill the ear with warm salt water, and introduce into it just below the surface, a bit of sponge tied upon the end of a flexible wire, connected with the positive pole of a low tension galvanic battery. With negative electrode held in either hand, and care must be taken to remove rings therefrom before cells are switched on, as they usually grow uncomfortably hot, begin with a single cell and slowly increase until a hissing or bubbling sound is heard. It may be that no sound will be audible until after several applications, and care must be taken not to increase current strength beyond six or seven cells at farthest. In favorable cases four will prove sufficient. Continue the application for ten minutes at least, slowly decreasing battery power until at the close, the switch is again at zero. Relapses after cure are not infrequent, and must be patiently treated in the same manner. Faradism should never be resorted to about the inner ear, as muscle contractions thereby awakened sometimes produce serious effects upon the ossicles.

Case.—Miss D., a strong, healthy blonde, seamstress, aged twenty-six, consulted me last winter for

deafness following a playful slap on the side of the head received some ten days previously. Inflation showed the eustachian open, and no abnormal appearance could be discovered about or in the external meatus. She could not hear my watch tick, except in contact with her head. Treatment as above for five days restored the lost sense, which still remains normal.

CHAPTER VII.

DYSPEPSIA.

Among the diseases which originate in or primarily affect the digestive tract, there is none wherein a physician's aid is more frequently invoked than dyspepsia, nor any in which medication alone is more futile. Americans are particularly prone to suffer therefrom, and one form—nervous dyspepsia—is so prevalent amongst the upper and middle classes of our countrymen, as to deserve richly the local celebrity to which it has attained among us. To speak of the causes which lead to so uncomfortable a result would be only to recapitulate what every educated physician knows well; and yet a few words upon dyspepsia as a neurosis will not be amiss in the present connection. It dates from the early settlement of the States and the environment of our sturdy colonists. Coming from the comparatively equable climate of Great Britain, where heavy moist air and few violent changes of temperature were the rule, where custom and country enjoined and permitted a steady diet of nitrogenized food, they found themselves exposed to rigors and heats of the most fickle climate in the world, where sudden and violent vibrations of barometer and thermometer are common, where the average yearly humidity is much below that of England, and where a six

months' winter enforced a diet of salted provisions for half that time. Salt pork, salt beef, bread, and pie formed the staple food, and in some parts of the States still compose a large portion of winter diet. Given such an atmosphere, tending steadily and surely to absorption of adipose tissue by dryness, and such a food supply continued unremittingly through several generations, a new race, so far as nervous explosive energy is concerned, has been rapidly evolved, and Americans of the nineteenth century are known throughout the world as exponents of nerve derangements. Bristling with points of weakness, they nevertheless continue in the front of life's battle as if clad in panoply of steel, and fearlessly attack food which, for variety and indigestibility, would appall a European. The salt meat and mince pies of two ancestral generations have given them digestive organs which are as sensitive as a photographer's plate, and it is only in the larger towns and cities that they are even now learning wisdom in food. Merchants, bankers, and professional men hurry through their ill-cooked, badly served meals, as if each minute spent in mastication were so much dead loss of money, top off with a slice of restaurant pie or cake, and wonder how it is that they so soon have stomach discomfort and disease. Heredity in likes or dislikes makes itself manifest as well as in diatheses, and the cause of American nervous dyspepsia lies largely in the faults of an older time. It is one of the most intractable diseases known. Patients are rare who can be induced to follow dietetic abstinence for a sufficient time, or who will avoid what they perfectly well know will do them harm, when they feel a little

better. They insist upon devouring a hearty meal in the middle of business hours, and then diverting flow of nerve energy from the digestive organs into sharp business transactions, difficult professional cases, or heavy literary labor, continuing on in such course until absolutely driven to their doctor, where no patient is more unwelcome. But, when advice and drugs are failures, and dietetic rules useless, galvanism steps in with patient aid, and gives the temporary relief which is alone demanded—which would with proper assistance perform a cure if it only could have fair play. The help needed is intelligent, *persistent* change of food and of feeding; and this once conceded, I have found electricity to work well in every case. Galvanism and faradism should be employed at the same sitting, as follows: general galvanization with low-tension battery, commencing with one-cell descending current, and carefully avoiding vertigo resulting from too much force or transverse currents, should be practised for fifteen minutes. Then shift to the faradic machine, place a sponge-pad under the upper dorsal region, a large carbon plate over solar plexus, and send a moderately strong, fine current through the trunk, taking care not to cause contractions of abdominal muscles. If the electrodes have been properly placed, wavy lines of motion will be felt by the patient in the course of the colon, and may sometimes be seen through the abdominal walls. Continue this application for twenty minutes, and repeat both daily for as long as the patient can be induced to attend, which time has in my own experience been a short one. For relief from that indescribable sense of depression which a past age called

"goneness," is usually so complete and vitality is so vivid that antecedent ills are forgotten, and the quondam sufferer turns again to his version of the Epicurean maxim, "While we live, let us work."

CASE.—Mr. J. B. V., merchant, from the practice of Dr. Crosby, of Manchester, New Hampshire, aged forty-seven. Eighteen months before consulting me, after drinking several glasses of lager beer, was attacked with violent nausea, which inaugurated a severe attack of intestinal irritation, followed by obstinate constipation and intense dyspeptic pains in stomach. All food disagreed, and his nervous system, previously strong, was quite unstrung and exhausted. From a weight of 180 pounds he had rapidly emaciated to 125, and was so much weakened as to have about given up hope of cure. Pulse 72, weak and thready. Abdomen tumefied; stomach distended with gas, but not painful upon moderate pressure. Had frequent nocturnal pollutions, but none lately. Stomach rejects all food, and condition in general almost desperate.

Mr. V. came to Providence, in compliance with my instructions, and treatment was immediately commenced as follows: He was placed at rest in a quiet room, and fed every ten minutes with wine whey, alternating with milk and lime water in equal proportions. Central galvanism, with four cells of a low-tension battery, omitting the spinal current, was administered twice daily for ten minutes at a time. At first, and for two or three days, neither whey nor milk were retained, except an occasional dose which was very small, usually a teaspoonful. After that he gradually improved, until in two weeks he could take

small doses of Valentine's extract of beef and walk across the street to my rooms. No change was made in the diet except to drop the wine whey for another month, keeping up the double daily applications for that time. They were then reduced to one a day, and an occasional faradic application made to the bowels. In about three months he returned to Manchester practically cured, but compelled to adhere to a strictly simple diet to avoid a recurrence of the unpleasant symptoms. From that time, April, 1880, to the present (1887) he has suffered three relapses, owing to incessant application to business, which a couple of weeks' treatment have cured. Finally I arranged a battery for him at his residence, to which he occasionally resorts, and with due care as to excesses, has little further trouble, has regained his former weight and strength, and is once more a valued and active member of society.

I regard the result in this case wholly due to the well-known property of electricity which I have called "vitalizing," without which no food, however carefully administered, would have been assimilated. Each sitting was followed by a sensation of warmth and comfort which no medication, even in the hands of so skilful a practitioner as my friend Dr. Crosby, had been able to produce. No doubt galvanization was aided by the subtle effects of change of environment at first, but it was certainly the chief agent of cure.

CHAPTER VIII.

NEURASTHENIA.

NEURASTHENIA is now considered a general term indicating merely nervous exhaustion from any cause which may or may not be accompanied by loss of strength of other organs of the body. Indeed, a large part of those who have consulted me for this condition are large, robust persons, upon whom a casual glance would dwell in admiration of their apparent health. Appearances are here eminently deceptive, however, and an expert easily detects in wandering eye, unsteady hand and anxious speech grave nerve derangement. To treat neurasthenia successfully a physician must possess the absolute confidence of his patient, since success is quite as much due to mental as to physical therapeutics. It will never do to make light of an ailment that is so serious a matter to the patient. If, in his disordered sensorium, a certain space is closed to his transit as firmly as if by triple bars of brass, it is of no use to attempt to persuade him that they are flimsy as woven shadows: he *knows* better, and the barriers will not away at a word. No one who is not especially fitted to care for patients whose judgment is temporarily at a loss upon certain subjects, should attempt the care of a case where only infinite patience, unremitting tender care, and a regnant will can sway

the sufferer aright. And only when mental control is established does physical treatment find place.

In considering so important a subject as nervous exhaustion, I deem it best to adhere to the division of the subject made by me a few years ago in the New York *Medical Record*, in an article entitled, "Types of Neurasthenia," wherein cases were described as belonging to cerebral, gastric, and sexual exhaustion, arising from different causes, presenting different symptomatology, and requiring different treatment. Dr. Corning, in his late work upon brain exhaustion, has expressed what is undoubtedly the general opinion of the profession at present, that exhausted conditions of the brain are curable. But to treat all cases of nerve tire by brain rest is manifestly illogical, for in gastric and sexual types, cure is practicable without interfering with brain work. Neurasthenia from cerebral exhaustion is chiefly marked by occasional vertigo coming on after a sense of darkness, followed by a headache, and accompanied by an acid, metallic taste, something like that of galvanism. Words are dropped or are difficult of utterance, and an indescribable anxiety destroys comfort or pleasure in life. Business cares assume heavy weight and friends are doubted. In fine, for the time being life is a burden, and occasionally prospects of casting it down are seriously entertained. Morbid fears, in my own cases chiefly fears of places, become living obstacles to action, and the patient is a nuisance to himself and his friends. Here nothing can be done in the way of treatment until change of occupation, and if possible, change of environment, is effected, the former being always feasible in the case of a brain-

worker, the latter frequently out of the question. When once a writer has laid down his pen, a student his book, or a teacher has dismissed his scholars, I have rarely found need of any drug to effect a cure. Galvanism has always proved sufficient, and is applied as follows: When the patient comes in, place him in a quiet room until all agitation of nerves is past. Then, with the feet in a basin of warm salt water, in which is also the negative pole of a low-tension galvanic series, place a large, soft, wet positive pole sponge upon the top of the head, having thoroughly moistened the hair, and slowly switch into circuit six or seven cells, one by one. The current should be just strong enough to be felt as warmth on the head or distinctly tasted. Continue this downward application for fifteen minutes and stop. Patients will usually be very sleepy, and should have a quiet nap of an hour immediately. I do not even permit them to dress before lying down, and this sleep is profound and refreshing in the extreme. It is rare that I have been forced to continue treatment longer than a month, even less time frequently proving efficacious.

CASE.—Mr. J. B. K., aged thirty-six; native of Rhode Island; bookkeeper and manager; family history one-half consumptive. During our late war Mr. K. received a blow upon the top of the head from the handle of a pitchfork, which knocked him senseless for an hour. Some months after injury was prostrated by the sun, and carried to regimental hospital for a day. Nothing followed these incidents, however, and he returned home after the war to assume a bank position. Five years ago began to

experience general uneasiness whenever in a room full of people, and was obliged gradually to give up society. Attacks of vertigo became more frequent, and it finally became necessary to avoid crowds entirely. Next came topophobia, to the extent of quite preventing his crossing Exchange Place, one of our open squares. This was accompanied by explosive nervous discharges, sounding as if a pistol had been fired inside the skull, and constant dreams of a voluptuous tendency. Temperature, 101.5 mouth; pulse, 76, thin and jerky. General functions normal, and patient presents the appearance of robust health, weighing 165 pounds, ruddy and strong. Treatment was commenced September 1st, 1880, as above described, and was continued for four weeks with happiest effect. No trace of difficulty remained, and he returned to business. In six months afterwards Mr. K. reported again with the same train of symptoms, which a similar course again relieved, and he has usually found it necessary to repeat the treatment at least once a year, never more than twice, to keep him right. I believe that if it were possible for him to have a year's complete rest, there would be no further trouble. At the present writing, 1887, Mr. K. reports that he has had no return of the difficulty for nearly two years.

Gastric neurasthenia is much more common than cerebral, as dyspeptics and over-feeders are more common than brain-workers. When the digestive tract is so far enfeebled by abuse or disease as to be quite unable to respond to stimulus of food ingestion with flow of solvent acid juices, and only worries through its task with infinite labor, nerve exhaustion

ensues, in common with loss of general tone. These cases are very frequent. Besides the usual symptoms of dyspepsia, head pain, foul tongue, etc., there is present a group of nerve changes, functional in character, which are distressing in the extreme. The heart's action is interrupted and feeble, with simulating murmurs, extremities are cold, face pinched and anxious, with frequent vertigo. Words are dropped out of sentences spoken or written, memory becomes treacherous, and the most even temper grows impatient and irritable. With increasing emaciation functional paralytic symptoms come on. There may be patches of local numbness, formication, or dragging of one leg. I have now one patient who has spasmodic movements of both little fingers about ten minutes after eating. In some of these cases which have resisted for a long time every form of medication, every diet formulary, electricity comes promptly to the front, and acts well. Galvanism and faradism should be combined. Central galvanism, employing the full treatment, should be applied for twenty minutes in the forenoon, using ten to twelve cells of a low-tension battery, equivalent to one and a half milliampere, and general faradization as late in the evening as may be convenient, with a very fine current, just strong enough to be distinctly felt. Always have the patient recumbent and undressed, with the flat sponge-pad under the sacrum. From that as a negative pole, use a large, soft sponge positive kept moistened with hot water, and go over the entire trunk and limbs, with long, slow sweeps. Guard against having the sponge too wet, or there will be danger of cold. In ten minutes nervous excitement

will calm down, and in twenty more the patient will generally be asleep. Of course, electricity in such cases does not in any way interfere with a rigid dietary regimen, which must always be enforced.

CASE.—Mr. J. M. H., contractor, aged thirty-two; native of Massachusetts; father died of cancer of mesenteric glands at an early age, and one brother of consumption. For seventeen years has been a sufferer from severe constipation, arising from irregularity in meals. About three months ago lost appetite completely, and forced down only sufficient food to support him; each meal followed by sharp pain in stomach and bowels. Can at present take only liquid food, and is exceedingly nervous and wakeful. Has severe attacks of nervous headache, lasting sometimes twelve hours, followed by sense of weakness of back muscles. Pulse 100, full and tense. Temperature, mouth, 100°. Urine normal. Retinal arteries enlarged and tense, with slight optic neuritis. Lungs and heart normal.

Mr. H. was placed under electrical treatment as above described, and grew better quite rapidly; but the demands of a large business were so imperative that resistance was impossible, and he soon relapsed. Again careful diet and electricity relieved the symptoms, but nothing could detain him from his affairs, and he finally died of inanition.

Sexual neurasthenia is frequently and with good reason described under the head of spinal exhaustion. But as I believe that the cord disturbance is here secondary to sexual abuse, I prefer the former nosology. It is not confined to men, although a majority of my patients are males. It is invariably slow of cure, and

in advanced cases frequently resists all efforts in that direction. It is characterized in the male by more or less complete loss of erectile power of the penis, flabby scrotum and pendulous testicles, by general nervous uneasiness in the presence of women, and by frequent nocturnal pollutions without pleasure and without dreams. It differs from impotence in degree rather than in kind, for patients of this class frequently procreate while impotents as often are free from other weakness. It occurs in men in the prime of life, and is nearly always due to sexual excess.

In women excessive venery is usually compulsory, since a majority of married women of the better class endure coition, not enjoy it, and submit to some brute of a husband after unavailing efforts to escape, when they would infinitely rather go quietly to sleep. Here functional nervous derangement is shown by abdominal neuralgic pains, by failing sight in early adult life and by localized patches of soreness upon the scalp. Hysterical phenomena are concomitant, as are also ulcerations of the external os and subacute vaginitis. Such a woman looks upon her marital bed as a veritable rack and her husband as a corregidor of the Spanish Inquisition, and begs her doctor, in piteous tones, to persuade her lord to let her alone. Such a plea has occasionally succeeded when supplemented by a glance through a speculum at the ulcers and foul discharge from the wife's diseased cervix and os uteri.

In either sex prompt and continued sexual abstinence must precede any treatment. But I have not found it either advisable or possible to enforce this with all men. Some cases will take refuge in a re-

turn to childhood's secret habits, or nocturnal emissions will rapidly increase in frequency, and great moderation rather than abstinence has been best in my hands. With women, however, the latter course is the only one, and there must be no delay in enforcing it as far as practicable. When this is successfully arranged electricity plays a most important part in the cure, being in itself quite sufficient to accomplish it in most cases.

With men I employ galvanism alone; I regard faradism as injurious in debility of the genital nerves on account of its too stimulant properties. Application should be made twice daily, if possible, as follows: Place the patient upon a stool, stripped so as to give easy access to the whole length of the spinal column, and under the base thereof a flat sponge electrode, connected with the negative pole of a low tension battery. Commencing at the nape of the neck make slow, steady strokes down the spine, using enough power to give a decided sense of heat. When the skin is bright red, which will generally take fifteen minutes, a sitting is done.

Great patience and a protracted course is necessary in nearly every case, and I usually recommend three months treatment at the outset, which is not infrequently protracted a year.

For women the procedure is radically different. Withdrawal of the exciting cause and local treatment of local lesions leave the system in the best possible form for tonic applications of general faradization, which should be made in the manner directed in the second chapter.

Recovery is usually prompt and complete—leaving

the nervous system, however, in a condition of accumulated irritability which breaks out anew upon small provocation.

CASE.—Mr. W. R. B., aged thirty, single, commercial clerk, five feet eight inches in height, weight 120 pounds. Commenced to masturbate at ten years of age and continued five years, when nocturnal emissions began and have since continued, averaging three or four times a week, not awaking. Has never had intercourse with a woman. Has a sore spot on top of head which becomes much worse upon attempting to read or apply himself to business. Considerable pain in back and spine. Is nauseated several times a day. Has frequent attacks of numbness of right hand and drops words when speaking, although conscious of the defect and striving to prevent it. Urine passes irregularly and in spasmodic jets.

After cauterizing the urethra with an electrolytic bougie spinal galvanism was begun and continued for five months, when the emissions were reduced to one a week, and patient became strong enough to attempt coition. Although a cure was not attained, the result is so far good that Mr. B. is about and attending to business.

Perhaps a majority, certainly a large proportion of patients consulting a neurologist in a given length of time are suffering from generative insufficiency. No disease, if indeed the hydra-headed group of disorders of mind, muscle, and nerve arising from this cause may be so termed, is so widespread, so generally understood to exist, or so rarely leads to a fatal termination as this, and, we may add, is so unsuccessfully treated. In the nature of things, this con-

dition has probably always existed, will always remain. When sexual instinct first makes its appearance in the pubescent boy or girl, there accompanies the development of its strong desires a demand for gratification so peremptory that it is rarely unheeded, and attains satisfaction either in waking or in sleeping dreams. The number of men who attain adult life without masturbation is surprisingly small, and is, I am persuaded, confined to those who have had early and constant intercourse with women, or who are arrayed in the ranks of nocturnal emissionists.

If a general inquiry were to be instituted among men of, say, twenty-four years of age as to how many *never* have masturbated, the result would astonish, not the experienced medical man who knows the facts, but nearly every one else, and might, perhaps, be doubted. None the less true, however.

The sexual appetite is one which will not be denied gratification when it comes upon a young man, and is scarcely less imperious than its fellow instinct of life preservation. A habit of self-abuse is contracted, in the male, from companions almost exclusively, and usually persists until the boy grows large enough to go into female society, where he speedily becomes inducted into the knowledge of genuine sexual pleasure, and abandons the old habit with disgust. So that impotence from masturbation is by no means as common as is generally supposed, but is usually limited to the class before alluded to as exceptional—those constantly with women or haunted by emissions.

Not only in the male; for I am constantly con-

sulted by women who are as useless in sexual matters as a log. They can neither receive nor give sexual delights—know nothing of the strong desire for male companionship which is a normal instinct, and, if conscientious persons, who have unwittingly entered the married state, are in lifelong discomfort, not to say misery. "Doctor," asked one, "what shall I do? My husband tells me that I am good for nothing, that he never saw such an iceberg, and that I must consult you in the matter; for, if there is any cure, I must have it, or he may not remain true." Alas, poor lady, there is none. You were born so, in common with many others of your sex, and to attempt to develop desires that only exist in a rudimentary condition is well-nigh a hopeless task.

So general is this condition of sexual apathy amongst women of all nations, that to find one whose desires are as strong as those of the average man is the exception to a well-known rule; and, were this as generally understood by the laity as by the profession, it is possible that much domestic infelicity might be avoided. Not to expect too much is to avoid disappointment.

While masturbation is much less common with girls than with boys, it still exists to a degree that would astonish any one ignorant upon the subject.

We are not so badly off as in France, if an eminent author is to be believed. Dr. Deslandes states that "a large number of little girls, and a majority of adolescents, are addicted to this habit." But there is enough of it with us, and it is a parent of many of the hysteriform nerve derangements of our young women. So marked is the peculiar expression

of one of this class, that one almost never makes a mistake in asking, during an examination, the plain question, "How many times a week do you practise self-abuse?" The reply, made with downcast eyes and blushing cheeks, "Why, doctor, how could you know that?" and a little judicious coaxing, soon makes the matter clear, and there is no trouble with the diagnosis.

In the treatment of these cases more men have grown rich than in California gold mines—for the pride of a man is his virility, and he will part with anything short of life rather than lose it. So that in all ages, charlatans have reaped a rich harvest from this field, and the nineteenth century still gives them a plentiful aftermath, for it is one wherein regular medicine has made such brilliant failures that physicians are chary of promises.

Damiana, phosphorus, strychnia, musk, nutmeg, and the various preparations of iron have all been faithfully tried as aphrodisiacs, and, with the exception of the first named, have been of greater or less benefit in selected cases. In my hands damiana has proven as useless as cundurango in cancer, and it is, I think, very generally discarded. The others are most valuable as general tonics, with perhaps a special remedial action in generative insufficiency, but I have never seen, outside of the Grand Bazaar at Constantinople, any drug which was a direct and undoubted aphrodisiac. There was a crimson elixir sold there a few years since which was certainly that —and which acted without any subsequent loss of power, so far as a limited experience of it warrants me in speaking, but its composition was entirely a secret.

Electricity has been employed for a long time in these cases, until quite lately by charlatans alone, and even in their hands has yielded good results. It is to call attention to a few points, which are perhaps novel in the application of the currents to the generative organs, that this article is written, although the long preamble might easily have led to another opinion. Early in my special study of electro-therapeutics, in 1874, the idea occurred to me that faradism could be applied to the male generative organs in a better way than by manipulation with rheopheres or the electric brush. I therefore devised a special electrode, in the shape of a cylinder of metal, within which plays a piston, the rod of which is surrounded by a weak spiral spring, bearing upon the inside of the closed end of the cylinder. Resting upon the piston is a pad of surgeon's sponge. The tubes are made of different diameters, varying from ¾ to 2 inches, and from 3½ to 5 inches in length, and during the application surround the penis, the sponge-pad, moistened with salt water, pressing against the glans. The current should be exceedingly fine faradism, *i. e.*, of rapid interruption, of high tension, and fair quantity. In other words, it should be as strong as the patient can bear without pain, and without shocks. Applied in this way, with a large negative sponge electrode at the back, under the lumbar vertebræ, the patient comfortably recumbent, the result is a strong stimulation of those branches of the sacral plexus composing the genito-urinary tract, and a corre-

sponding increase in muscle nutrition. The penis becomes turgid, the dartos contracted, and a close watch must be kept upon the patient, lest, by continuing the application too long, an emission be produced. By discontinuing the current after five minutes, or by increasing the electro-motive force until it becomes painful, this result may be avoided. By a steady persistence for several months in this form of treatment, I have succeeded in rescuing several patients from that worse than death to a sensitive man—a life of lost manhood. Applications should be made daily.

In cases of nocturnal emissions, a directly contrary course must be pursued, since the conditions are opposite, at least in a certain sense. There is as yet no loss of virile power; there is an intense hyperæsthesia of the genito-urinary tract, which requires no stimulus, which is directly injured by it. No tonics, beyond the general ones of outdoor exercise and plentiful food, can be depended upon, for they tend to aggravate the irritation of the excited nerve centres. For this reason faradism is inadmissible. I think that far more injury than good has followed its use, and abandoned it wholly in my own practice in these cases several years since. In its place I use galvanism derived from a battery of low tension—some modification of Daniell's element. It is applied by a Newman's urethral electrode, with olive tip large enough to gently distend the urethra. This is passed into the bladder, and the circuit completed through an electrode held in the hand, when it is slowly withdrawn, the whole operation lasting about one minute. If the slightest pain is experienced cur-

rent is too strong, and should be modified until only a sensation of warmth is perceived. This operation should be repeated daily for several weeks, and has been, in my practice, productive of the happiest results. One case, now under treatment in the eighth week, reports emissions reduced from three or four weekly to one in eight or ten days.

What can electricity do for apathetic women? I regret to reply, very little. Years of work in this direction have convinced me that no agent can overcome a natural lack of sexual passion. Faradism, general and ovarian; galvanism, spinal and central; franklinism in every form of application, have each been faithfully tried, and in turn have failed to effect any permanent good. If general health be good, I now recommend consulting women to abstain from all treatment for such condition, and rest content with their natural status.

There are, however, occasional cases wherein is a slowness of action of temperament, where passions are sluggish and torpid, which electricity is competent to remedy. Here spinal and ovarian faradization has proven most useful.

I cannot close this article without calling attention in the strongest possible manner to a point wherein I think the profession is culpably derelict. We do not insist sufficiently upon the necessity of home training. If every father and mother would talk plainly to their boys or girls, would explain to them the danger of secret practices, and how difficult to get rid of the habit once formed; if family physicians would insist upon such confidences between parents and children, much misery and shame might

be averted. In every case that comes under my care I ask: "Did your parents never tell you of the danger of self-abuse, and warn you against contracting the habit?" And invariably the reply is, "No, indeed." The influence of the house doctor in cultivated families—in all families, is greater than any one but himself can estimate, and his clients have the right, if it be an unsuspected one, that he shall use *all* his talents in their behalf.

CHAPTER IX.

NEURALGIAS.

NEXT in our list of diseases to be considered comes neuralgia. In itself but a symptom of other derangements, at least with rare exceptions, it has come to form a very large proportion of cases applying for electrical treatment, and the extraordinary climatic conditions of New England seem to have located it among us as a permanent resident. From this and from hereditary succession which is often well marked, we are becoming used to speak of certain nerve pains as separate diseases, which were formerly considered merely symptomatic of distant disturbance. Sciatica, cocydynia, tic doloreux, and the whole train of titles signifying pain either in the peripheral distribution of a nerve or in its trunk must be considered as separate and distinct maladies, calling for distinct plans of treatment. With the etiology of cases we have only so much to do as will enable us to secure the most speedy form of relief from pain, which is practically a cure of the disease. And here comes in a rule which long experience has led me to believe almost invariable. When the cause of neuralgia is central, or when it affects the trunk of a nerve, use galvanism alone. When the cause is peripheral or reflex, affecting skin tracts or muscle bundles, use faradism alone. When the disease is general, located

no place in particular and seemingly a constitutional affair, employ both forms, either successively or alternately. In the latter kind only have I found static electricity of any value, and then inferior in results to faradism.

It is usual for general practitioners, I think, to employ the wrong form of electricity—faradism—to trunk neuralgias. Comparatively few own a galvanic battery at all, and not many of those who do are aware of the different effects to be obtained from one of high tension and one of low tension. In all those cases which are central in origin or location I have long since abandoned the use of faradism, having satisfied myself that it simply aggravates the condition that I am trying to relieve. So does static electricity. But when a galvanic current from a low tension battery is established in the direction of the nerve force flow and continued steadily for a space of ten minutes, pain usually vanishes, or is distinctly lessened and the curative process begun. Nor is the reason for this difficult to arrive at when one considers the congested state of the nerve itself in all grades of inflammation—its compression within a strong unyielding sheath—and remembers that any increase of tension means increase of pain, and that whatever will lessen blood supply to the nerve will relieve both pressure and pain. Now it is absolutely certain that a descending current of galvanism traversing a nerve trunk will partially empty its arterial vessels of their contents, while an ascending one will promptly fill them, a fact which I demonstrated upon living animals in 1876, and from which I derived my theory of electrical treatment of neuralgia. Years of subsequent practice have

confirmed that theory, and I now believe that no case of neuralgia exists, uncomplicated with structural change of centres or nerve, which may not be cured by this procedure. When failure occurs it has usually been due either to the employment of a high tension galvanic current, a faradic current, or the proper one used incorrectly. Nothing is easier than to make light of these distinctions as entirely too fine drawn, but when one operator fails in a certain case and another, changing method, succeeds, there is very little doubt that the sick man will go to the last man first when his attack recurs. And he will be right.

Among neuralgias of central origin come the lightning pains of ataxy, facial tic dependent upon exophthalmic goitre, pains accompanying albuminuria, paralyses from brain or cord lesion, and the like. In sclerosis great relief from pain may be procured by galvanization of the cord as follows: With so much of the patient's back uncovered as will permit thorough access to the whole length of the spinal column, place the negative pole, connected with a flat sponge electrode, at the base of the spine, and, with a current of twenty cells of low tension series, draw the positive pole, in this case a button-shaped carbon covered with wash leather, slowly down the column commencing at the neck. When the upper border of lesion is reached it is usual that a distinct perception of different sensation will be felt. Very much greater heat or cold or more pain will be noticed, and it is from this point that the downward current should be directed. Reduce cells to five, and allow the flow to continue uninterrupted for fifteen minutes. Disconnect the upper cord from the screw-post and, tap-

ping its tip against the post, send a series of shocks through the cord just sufficient to be felt, at intervals of ten seconds. Great patience and care are necessary in these cases, and the treatment must be regular at daily intervals, continuing through months. In a majority of cases much relief is afforded, and in a few in my practice symptoms of sclerosis have been arrested.

Case.—W. G., aged fifty, jeweller; born in Rhode Island. A large man, evidently of considerable muscular power when in health. Commenced to notice a difficulty in locomotion two years ago, which soon became ataxic. Coincident with the establishment of lancinating pains in the sciatic nerve and its branches, his eyesight began to fail and he was obliged to quit work. Had been steadily losing flesh for six months previous to consulting me, and could no longer stand without support, even with wide-open eyes. Backward locomotion impossible. Sexual appetite abolished. Numbness and formication in both legs and mental powers unimpaired. Tendon reflexes gone.

Treatment was at once commenced as above, with a cauterization of the spinal cord region once in two weeks, and continued steadily for five months, making daily applications. At the end of that time he was advised to make a change of climate and rest, and accordingly spent three months with friends upon the Hudson river. Returning, operations were renewed for four months longer, with the very comfortable results of entire cessation of pain, sound sleep, and greater steadiness of gait. Mr. G. then returned to his bench at Attleboro, and worked steadily for a year, when pain recurred and he gradually succumbed,

finally dying of exhaustion, too much discouraged to attempt further treatment.

Austie, in his admirable work, *Neuralgia and its Counterfeits*, places the pains of locomotor ataxy among those that only resemble neuralgia, but I cannot agree with him. If not neuralgic in the fine distinction which he draws, they are sufficiently so for our purposes, and may be relieved by persistent galvanic treatment.

Facial neuralgia from pressure upon the ocular branch of the fifth nerve in exophthalmic goitre is almost an invariable accompaniment of that formidable disease. Its treatment will be described when we come to the consideration of the malady.

During the progress of Bright's disease, in its very earliest stages, most violent neuralgias of the supraorbital, malar, and temporal branches of the trifacial occur, and I have diagnosed the disease from these pains, together with retinal patches, before any trace of albumen was to be found in the urine. The small amount of relief afforded by any form of electrical treatment in these cases in my hands has led me to abandon it for internal medication. But in later stages, when dropsy has supervened and superficial tissues are distended with serum, great relief is frequently afforded by general faradization. Indeed, the stimulant effect of this current, applied with a fine wire brush, has more than once completely relieved skin tension and made life again comfortable. And I am glad to recommend it in anasarca from any cause. In such cases as powerful a current as can be borne by the patient should be used over the whole body for a full hour at a time,

and repeated daily if possible. Without accepting the theory that all neuralgia is dependent upon some centric material change, there are certain varieties which so evidently accompany centric degeneration as to merit close attention. Chief among these are muscle pains in paralytic affections. During the progress of a case of hemiplegia, brachial and sciatic neuralgias are quite common, and constitute the most annoying symptoms of the disease. Rest by day or night becomes impossible from steady pain, which only yields to large doses of morphia, with subsequent ill-effects of nausea and depression. Here the constant current plays a most important part, and procures for an unfortunate sufferer that relief which is so important a desideratum. In treatment of these cases, I prefer above all others Dr. Radcliffe's plan of free galvanization, as described by him in his work, *The Dynamics of Nerve and Muscle*. "In a case, for example, of cervico-brachial neuralgia, we place the positive pole as near as may be to the origin of an affected nerve; the negative pole is held in the hand of the same side, which is immersed in a basin of warm, salt water. In this same basin is another electrode, the wire from which is put in communication with the earth (grounded) most conveniently by putting it in contact with a gas-pipe. Patient and battery must be properly insulated. The result of this arrangement is that free negative electricity is carried off by the earth wire, and the limb remains charged with free positive electricity." In all cases of neuralgia in trunks of long nerves I am in the habit of employing this method, and have obtained better results than in any other way, more

especially when the negative pole not grounded causes a severe sensation of burning. Among excentric neuralgias most frequently coming under our notice are sciatica, facial, intercostal, lumbar, crural, uterine, ovarian, and cardiac.

A majority of cases of sciatica are rheumatic in origin, the result of exposure to damp cold, or are malarial. While appropriate constitutional treatment must never be lost sight of, there is no doubt that pain may be relieved in almost every case by a descending galvanic current. It must, however, be used in strict consonance with directions already given, or failure may be predicted; and here is a good place to reiterate the fact that only galvanism is applicable in trunk neuralgia. Faradism has proved worse than useless in my hands, and I cannot too strongly deprecate its use. In an ordinary case of sciatica the method is as follows: With the foot immersed in a basin of warm, soft water, taking care that the ankle is covered, place the negative pole beside it, *not touching*, and make firm pressure over the nerve at its exit from the ischiatic notch with the positive attached to a small button, as this will allow a more careful localization of the current in the nerve than a larger plate would do. Direct a current from five cells of a low-tension battery through the circuit, gradually increasing to twenty or more, the guide being the patient's sensations. Give him all he can bear. As the skin under the positive pole becomes red and painful, move it half an inch along the course of the nerve, being careful not to break connection or a shock will follow—just what we do not want. Continue the application at least twenty minutes—better,

thirty—and repeat daily. The best time of day is toward evening, as sciatica is usually worse at night. Three weeks is the longest period that I have continued treatment for this form of sciatica, relief from pain usually following the first dose.

CASE.—Mr. H. F., manufacturer of heavy machinery; age, thirty-five; height, six feet; weight, 175 pounds, and robust in appearance. Disease commenced four months before, and, as he grew no better under the care of one of our prominent physicians, his case was referred to me for electrical treatment. Pain had been so severe that motion was restricted, and atrophy with lameness had begun. Upon the above plan treatment was begun, and continued at intervals for more than a year. Each application was followed by relief, and his nights were comfortable and restful. In spite of every constitutional care, the disease persisted in recurring, becoming worse as cold weather came on. Finally, I advised Mr. F. to go to a warmer climate for March and April, and he spent those months in Cuba and Florida, with so good a result that he has not been at my rooms since. In this instance a cure was not obtained, although relief from pain was very marked, and Mr. F. was an excellent patient.

Facial neuralgia is usually a result of exposure to a current of cold, damp air, of carious teeth, or of what seems to be a habit. In cases of the latter class everything in the nature of mental excitement brings on sharp facial pain, which rapidly intensifies until it reaches the dignity of neuralgia. In these cases also I have noticed a curious phenomenon, due apparently to vaso-motor sympathy with the painful nerve.

About an hour after pain has reached its climax the eyelid and cellular tissue around the orbit of the affected side become tumefied with extravasated blood at times, so as to completely close the eye. After the pain has subsided swelling slowly disappears, leaving behind a genuine "black eye," exactly as if a severe blow had been received. In my own case this has sometimes gone so far as to disfigure face for several days. Whatever may be the cause, mode of treatment is the same. Using a low-tension current from four cells, place the positive pole connected with a small carbon point, over the mastoid foramen of the affected side, and stroke the face with a large, soft sponge well moistened with salt water, following always the course of distribution of nerve branches. Never send the current inward. When the median line of the face is reached remove the sponge, and start again from the negative electrode. Have the room quiet and dark, make only slow, steady strokes, and the result will be excellent. Pain and irritation disappear like magic, and the patient usually falls asleep during the sitting. Two or three applications are usually sufficient to cure any recent case. If there are bad teeth, it is useless to attempt anything until they are attended to, and it is best to decline interference until after a dentist has been consulted.

Intercostal neuralgia is frequently very distressing, and in two of its varieties comes frequently forward for treatment. These are the mammary pain which comes on with most women just before or during the menstrual period, due to intimate sympathy between mammæ and uterus, and the pain attendant

upon certain cases of herpes zoster. Sometimes mammary neuralgia is a constant accompaniment of pregnancy, but in this case it seems to be due to mere increased weight and consequent traction upon the skin and pressure upon intercostal nerve branches below. It is best treated as follows: Place a flat negative sponge electrode under the dorsal vertebræ with patient recumbent, and envelop the whole breast in a soft towel well wetted with salt water. Mould a square of tin-foil so as to cover the towel closely, and attach the positive pole thereto by a fine insulated wire, which may be made to pierce the foil. Switch on gradually as many cells of a low tension current as can be borne, which will usually be about fifteen. When the treatment has lasted fifteen minutes it should be sufficient. If it is, the skin will be of a bright red and pain gone. If not, continue ten minutes longer. One sitting is usually sufficient for each recurring attack. I have in my practice ladies who have been coming for years at monthly intervals for relief of this form of neuralgia, and they have, with rare exceptions, gone away quite free from pain. I am frequently asked by general practitioners: "Is there not danger in using a galvanic current in the region of the heart?" I cannot think there is the slightest. In my hands it has proven powerless for harm and potent for good. There is no theoretical reason why it should be injurious, and in my experience I have never seen any ill-effects follow its use in any dose, where all shocks have been avoided. But the same cannot be said of faradism, whose powerful contractile current may be made to affect cardiac muscles with startling effect,

especially if the phrenic nerve is in any part of the circuit. Care must be exercised in using faradism about the heart, but galvanism is safe in any careful hands.

The pain accompanying shingles shows conclusively neurotic origin of the disease. It is by no means always acute, not even always present. But when it does occur, it is clearly reflex in nature, and is of the most wearing kind. During the past year five cases have been treated at my rooms with unvarying success, relief from pain being immediate and complete and a cure rapidly following. My method is as follows: Provide a strip of thin flexible spring sheet copper, wide enough to cover the entire eruption, and have it covered with two layers of soft flannel. To any part of it—the front will be found most convenient –have soldered a copper conductor. Place the patient seated upon an electric stool or a flat sponge electrode connected with the positive pole of a low tension galvanic series, and connect the positive with the copper belt. Switch on ten, then up to twenty or more cells, as they are borne. I have found that as many as forty could be readily borne in some cases. Fifteen minutes is long enough for one treatment, and it must be repeated daily, a cure being attained in ten or twelve days. It is really marvellous to see how general nervous irritation, which is so distressing a symptom of herpes zoster, disappears under such applications as this, along with the pain.

Continuing the subject of neuralgias affecting viscera, we shall next consider the cardiac form, angina pectoris, as it is rightly and graphically named. Its

etiology is usually obscure, but immediate cause is invariably an overstrain of the heart muscles. Now this overstrain may arise either from an insufficient trophic supply from cardiac spinal centres, from some degeneration of the coronary arteries, or from actual overwork of the organ itself. In either case the attack begins in the same way, and is amenable to the same treatment. Perhaps a brief sketch of an unpleasant experience of my own with this formidable disease will illustrate its course as well as a hypothetical case. In 1867, while attached to the U. S. frigate Potomac, at the Philadelphia Navy Yard, I went from my boarding-house, on Third street, near Spruce, to the Continental Hotel on an errand. While there a storm came up, and, as there was then no direct way of getting back but walking, I started on a sharp run, which was kept up all the way home, more than a mile. When the front door was passed there came to my heart a sensation as of a strong hand squeezing it, at first not at all painful, with a slight difficulty of breathing. When my room, on the third story, was reached I sat down, and my wife asked whatever was the matter. The sense of compression rapidly increased until pain became agony and death seemed at hand. Dim dreams of the past grew clearer as suffocation increased, and at length, with a parting groan, all earthly things vanished, and what was to me death had come. Before this, however, a physician had been summoned, who luckily happened to be in the same house, and still more luckily happened to have some nitrite of amyl in his room. He has since told me that, when he came in and saw me on the floor,

with face the color of light gray ashes, pulseless, and apparently without respiration, he was convinced that it was only a cadaver to which he had been summoned. But he poured some amyl on his handkerchief, placed it over my mouth and nose, and began vigorous artificial lung inflation, with final success in restoring action to the heart, and I revived. Return to consciousness was not much less painful than exit therefrom, and life soon became a burden again. Weeks elapsed before I could move again faster than a walk, and to-day it is impossible to climb elevations. Slight attacks often come, but are easily averted by the use of galvanism and rest. Angina pectoris is so sudden and acute in its onset that there is no time to hunt up electrical apparatus; one must use the remedies closest at hand. But when a tendency thereto persists, and opportunity is afforded, it may often be lessened in frequency and its pangs mitigated by galvanism applied as follows: With the patient recumbent, place the negative pole of a galvanic series under the first three dorsal vertebræ, attached to a flat sponge electrode, and connect ten cells of a galvanic series, either of high or low electro-motive force, through the body to the apex of the heart, over which should be pressed firmly a large positive sponge. In five minutes pain will decrease, and the application should not exceed ten. In all cases where there is no certainty that the great nervous centres are involved, and the cause of any case of angina pectoris is still *sub judice*, I have been unable to distinguish any difference between ultimate results obtained from a current of high or one of low tension, the main point being not to lose time

in getting to work. It is not necessary to continue applications beyond a few days, as the acute part of an attack usually lasts but a few hours, and careful avoidance of anything like overstrain will prove the best prophylactic.

Lumbago, lumbar myalgia, muscular rheumatism, a crick in the back or a stiff back, while not a true neuralgia in the sense that only a nerve-trunk pain may be accurately so termed, comes nevertheless within our sphere of study nearly every day, and its electrical treatment is almost always successful. Usually the result of exposure to cold or of an excessive demand upon the great erector muscles of the trunk without adequate supply of nutrition, an overdraft on nature's bank, it is one of the most painful and irritating diseases of its class. Every motion aggravates its sharp pangs, and temporary relief can only be obtained by assuming and retaining a posture which will insure complete relaxation of all muscles involved. It is the result of lymph effusion among muscle fibres, agglutinating them and thereby preventing their smooth play in contraction or extension. Electricity—faradism—plays so excellent a part in curing this painful affection that it is unnecessary to supplement its proper use with any other treatment whatever. Galvanism is useless, for it fails to supply the agitation and superficial stimulus which alone start absorbents to a sense of duty and mechanically exercise dormant muscle fibres. Sometimes galvano-puncture will relieve pain, but the resultant soreness, as a rule, is so great that it has been practically abandoned for the other plan, which is far more pleasant and effective. Its applica-

tion should be made thus: With the patient dressed in a loose wrapper, which can be unbuttoned so as to give access to the whole lumbar region, seat him upon a broad copper plate upon a stool to which is connected one pole of a faradic machine. The plate must, of course, be covered with a pad of well-moistened felt or flannel, and it will be more comfortable if it is a little concaved. With the other pole connected with a large soft sponge—the current direction being altogether unimportant—stroke the back slowly *upward* with as strong a force as can be borne without increase of pain. In a few minutes a grateful glow pervades the aching muscles, and in twenty or twenty-five the application has become so pleasant that its continuance is begged. When the patient rises stiffness, pain upon motion, and that nervous feverishness born of a sense of fear of pain, have disappeared, and the trunk straightens up with ease. But lumbago is not an enemy to be dislodged with one attack. To be effectual, electrical treatment should be repeated morning and evening; both to preserve the muscle fibres clear of impediment and to keep absorbents up to their work. Usually two days is enough for any moderate or recent case, but severe ones rarely yield completely inside of a week. Much the same plan of treatment is to be adopted in all cases of myalgia. Always make the electrode move toward the centre, never from it. Applications should be frequent, not less than twice daily, and may be alternated with friction with stimulant liniments, although this is generally to be avoided, as it produces an irritation of the skin that is apt to make faradism too painful to be borne.

A large proportion of American women suffer more or less with uterine or ovarian neuralgia. Attacks are usually periodical, accompanying or immediately preceding menstrual periods, and when not distinctly due to this disturbance are apt to result from organic change. Numberless causes have been assigned why a large majority of our women suffer with monthly pain, any one of which would be sufficient in cases where causation is well marked. But there are many others in which the most rigid examination fails to develop adequate origin, and we are forced to prescribe empirically. Just how few women have a healthy set of generative organs is a problem of which medical men alone know the gravity, and it is probably safe to say that there are few females living of twenty-five years of age who have up to that time experienced no painful local disturbance before or during their menstrual periods. "Propter uteri, mulierum sunt," but why doctors should find the greater part of their work with women cut out by the uterus and ovaries is a question that admits of many answers. Doubtless our civilized customs of dress, our lack of systematic gymnastic culture for girls and hot-house system of forcing have much to do with it, but not all, for I found when visiting some of the South Sea islands a few years since in a professional capacity, that their women, who cannot be accused of refinement of dress or lack of open-air exercise, were affected by derangements of the generative system by almost as large a majority as our own. Besides, if dress and fashionable dissipation were the main faults, medical men recognize with regret the utter futility of attempting reform. Try it

with any lady with whom an intimate acquaintance is maintained, one's wife or daughter, for example, and see if anything short of absolute force will induce her to abandon corsets. She doesn't wear them tight, oh! no; but if a flat hand can be introduced between stays and skin it will be a wonder. It is more than probable then that neuralgias of uterus and ovaries will continue to play an important part in gynecology, and it is fortunate that we have in galvanism an agent which is able to cope successfully with a vast majority of cases.

The pains of dysmenorrhœa are certainly neuralgic in a large number of cases. There was a time when about every woman who complained of monthly pain was suspected of occlusion or some mechanical obstruction to the flow, and the wonderful success of the late Dr. Sims with his razor-bladed knives led to a species of rage for splitting and dilating the cervix. Later experience has led to the opinion that a majority of these operations were unnecessary, at least in the hands of those less skilled in diagnosis than the great gynecologist, and that the pains are neuralgic in character, amenable to such remedies as are usually employed in neuralgias. Perhaps self-abuse, which is more widely spread among women than any but doctors would credit, plays an important part in causation, and it is well to decide that point before going farther, in diagnosing etiology. But these pains exist as well among married women in full exercise of sexual functions and without any well-marked reason whatever. Beginning a day or two before the periods, it persists until the violence of flow has passed, then slowly subsides, leaving

behind a passive soreness and tenderness, which usually lasts a week or ten days. Hypodermic injections of morphia or vaginal suppositories of opium relieve the pain, but are almost certain to interfere seriously with general constitutional health, and are better avoided. In all these cases I have found galvanism exceedingly useful, and employ the following method: With the patient recumbent, place a well-moistened flat sponge electrode, such as Flemming, of Philadelphia, has just made after my design, under the cervical spine, and introduce into the vagina a metal ball covered with well-greased wash leather, pressing it firmly against the external os. The handle or stem may be made small, and must be well insulated, and, by having the balls made of different sizes, the os may be reached in unmarried women without damage. Pass downward—*i. e.*, positive pole above—galvanism from a low tension constant current battery, commencing with five cells and gradually increasing to fifteen, if so many can be borne, for twenty minutes, when the pain will usually be greatly relieved. I have found the effect much better when the whole spine is in circuit than if only the lumbar plexus is made the positive entrance; why, I cannot tell. Applications must be continued daily until menstrual flow is well established, and repeated monthly until a cure is effected, a matter of indefinite time. Occasionally a woman is met with whose sexual feelings are aroused to a high degree by the presence of anything in the vagina. In such cases self-abuse is usually carried on to a great extent, and the vaginal electrode must be dispensed with for a second sponge pad under the sacrum; but this method is far less effectual.

Miss J. B., aged twenty-eight, lady's maid. Miss B. was sent to my office by her mistress after suffering years from what she supposed to be dysmenorrhœa. Pain began three days before the period and continued quite through it, laying her aside for a week in all. A fine, buxom woman, sensible and intelligent, she said that the disease had existed for six or seven years, steadily increasing in violence. She had consulted several excellent general practitioners, without relief, and was inclined to melancholia, believing her case to be hopeless. Inquiring carefully into her antecedents, it transpired that about the time of inception of neuralgic pain she had separated from her young man, and had not up to date taken on with any other. While examining the uterus with an ordinary bivalve speculum, which opened to its widest extent without pain or trouble, signals of sexual excitement were exhibited, and I was obliged to remove the instrument to avoid a venereal orgasm. The conclusion was plain that Miss B. had been accustomed to coition while with her young man, and, deprived of it, had resorted to self-abuse, and neuralgia at the menstrual period had followed. Galvanism was applied from cervical spine to sacrum, and ethereal tincture of iodine applied over the ovaries, with considerable relief at the time, but a summer vacation has interfered with treatment, which will, it is hoped, result in a cure if she will take the balance of the prescription and get married.

The ovaries are peculiarly susceptible to neuralgias, as might be expected, when the copious nerve supply and complicated functions of those organs are consid-

ered. No age nor rank in life is free from these cases, and a careful examination of my case-book gives one-tenth of the entire number of female cases during the last year as arising from or dependent upon these organs. Beginning with puberty and continuing to the grave, there are no organs in the body more susceptible to functional and organic disturbance than these, none whose copious nerve supply and complicated functions more predispose to neuralgic pain. In considering them we shall first allude to those affections dependent upon non-organic cause. Some women are of such intensely irritable nervous make-up that the smallest excitement, the least interruption to the ordinary train of daily life, will cause an explosion which must be felt somewhere, and quite frequently we find the centre of the hurricane, the fons molestiæ, in the ovaries. If not just in the middle, the fury of the storm is pretty sure to be in that immediate vicinity, and more or less wreck is inevitable. A patient comes into the office: "Doctor, I have a pain across me —" "Well, please put your hand over the seat of pain," and down it goes to the suprapubic region. Examining digitally there is possibly some tumefaction externally, with tenderness on pressure, vaginal heat, and nothing else. Occasionally the ovary is hard enough to be felt through the vaginal walls, but not as a rule. That is all the touch can discover. The pain is a steady, deep-seated ache, with sharp twinges running backward or down the legs. No fever, but intense nervous irritability, frequently amounting to mild hysteria, with a desire to urinate frequently, passing large quantities of pale urine. This is functional uterine neuralgia and is

amenable to galvanic treatment, only it must not be protracted, and in commencing it the precautions previously spoken of must be carefully observed as to skin protection, or slow-healing ulcers will be caused. With patient recumbent and a positive pole flat sponge electrode under the crest of the ilium on the affected side, or in the centre when both ovaries share in pain, connect the negative with a small sponge-covered carbon button not more than an inch in diameter. Press the button slowly but firmly over the organ, working it downward until it has reached as close proximity as possible thereto, and connect on ten cells of low tension constant current. After fifteen minutes reverse the current sharply, reducing number of cells if the shock should be painful, and make a dozen of these voltaic alternatives, which close the sitting. It should be repeated at least daily until all pain is gone, when further electrical treatment is useless. Constitutional and mental hygiene must be relied upon in the interim between attacks to restrain mischievous tendencies, which are too frequently at the bottom of the whole.

When there is distinct organic change, as in cysts or fibromata, with large increase in size, severe neuralgic pain may result from direct pressure upon important nerve trunks, or be excited in a reflex way, from distention of the peritoneum. These pains I have never been able to do anything for, although every form of electricity has been faithfully tried, and I cannot advise its use.

Case I.—Mrs. H. N., from the practice of Dr. Chase, Newport, R. I., aged thirty-six, married, two children. Of a bilio-nervous temperament and poor

family history, two relatives having died consumptive. Has had no serious uterine disease nor difficult deliveries. About three years ago began to have well-defined sore spot in right ovarian region, not affected by cold, dampness, menstrual molimen, nor variations of general health. Steadily increasing in severity it attained, about nine months ago, a pitch at which she could no longer attend to her household duties, and she went to bed. Every possible care was lavished upon her by family and skilful physician, but she steadily grew worse until Dr. Chase brought her to Providence for consultation. Under ether a careful examination was made, developing an enlarged prolapsed right ovary, a slight degree of cervical enlargement, some superficial erosions of the os externum, slight cervical leucorrhœa—and nothing more, except a small amount of tumefaction in right groin. Dr. Chase's opinion was to the effect that her previous habits and character were entirely correct, which a subsequent close surveillance of four months quite confirmed. While coming out from the ether the affected region was discovered to be exquisitely sensitive to pressure, even the weight of clothing causing great pain. A diagnosis of ovarian neuralgia was made and a course of six months treatment entered upon, the application being made as above directed. For the first seven weeks they were twice daily, and now, after not quite four months, she is well on the road to recovery. All pain as well as tenderness disappeared three weeks since. Her last menstrual period was almost painless. She can walk half a mile without aid, and has gained twelve pounds in weight. There seems but one obstacle to a complete cure—the

holding out of Mrs. N.'s patience against so long a period of treatment. Of course, her complete rest from all care and worry, with isolation when needed and perfect hygienic surroundings, count in the result, but the only therapeusis employed was electricity. It is worthy of note that no night for some weeks previous to her coming to Providence had been passed without morphia to allay the pain, and that but a single dose was administered ever since.

Since the above was written Mrs. N. has had three years of excellent health, and has again become an active member of her home circle.

With ovarian we conclude our practical hints upon neuralgias, and will in the succeeding paper commence the consideration of some children's diseases which are excellently treated by electricity.

CHAPTER X.

DISEASES OF CHILDREN.

In commencing consideration of such diseases of early life as are amenable to treatment by electricity, I shall follow the division of Dr. Charles West, and speak of them with reference to sensation, to motion, and to the power of speech. In early life, pain is rarely, if ever, a disease by itself; like the neuralgias of adult years, it is a symptom of disease. Our little patients cry or scream or whine, but never without cause, and the careful physician, who knows that a baby's language is as expressive in its way as his own, and who has learned to interpret its tones, will be sure to discover that cause before his search is done. To be a good child's doctor, requires a mixture of woman's tender tact and loving sympathy with man's trained perception and firm decision, a combination sufficiently rare, yet by no means unknown. The unformed baby brain can give no intelligent answer, can only send along its optic nerves such supplicating, pitiful appeals for help as touch the coldest heart, and make every watcher long to give needed aid.

Nerve disorders of early life are apt to be severe in nature, serious in result, and it is perhaps well that they are comparatively limited in number. The child's nervous system is undeveloped, is in process of growth, and lacks capacity for serious injury as its

osseous skeleton is incapable of complete fracture. There is within the nerve centres of the infant an excess of supply over use, the surplus going toward new cell formation as a regular process. But it results frequently that some interruption to the stream is followed by a damming up of energy which finds an exit in an explosive way without any of the importance which a similar occurrence in an adult would carry with it. Indeed, as Hughlings Jackson says, a child's nervous system is physiologically so unstable that the least excentric irritation may produce an explosion. It is necessary to bear these points in mind when approaching diseases of nerves among children, as well as the fact that they are naturally far more excitable than their older brothers, as well as far more amenable to treatment.

Electricity acts upon children with peculiar force and in a peculiar way. Contrary to what one would naturally suppose, they bear currents of much greater relative strength than adults, only provided that no shock is given and that they are not frightened. Once a child has fear firmly impressed upon its mind, treatment is useless. To use force is simply to invite a series of hysterical events or even to induce convulsions of even more serious nature. There is never any need of this. Instruments are regarded with curiosity or amusement, the hum of vibrating armature of a faradic machine is attractive, and if care is exercised in commencing the application, it will be enjoyable rather than frightful. I have found it always best in using a current for tonic purposes, to employ the bath. The flow is thereby evenly diffused over the surface, much higher potential may be em-

ployed, and the child will rarely notice that anything is being done. Only no salt must be put in the water. The rationale of the proceeding is that blood being a better conductor than fresh water, a current will traverse the body from pole to pole rather than go around it through water. That this is true, experience has amply proven and a single experiment will demonstrate. Current direction is a matter of considerable importance in many cases, but no general rule can be given. One sponge pad, or what I regard as preferable, a round carbon plate, should be suspended at the head of the tub, a few inches from the patient's back, never in contact with it, and attached to the positive pole, the negative similarly arranged at the feet. With the switch pins and draw tube of Flemming's faradic machine a graduation of current may be obtained from very weakest up to a strength as great as can be borne. There are few cases where galvanism is required, as there are in childhood few disorders of nerve centres, and the tonic influence of a mild fine faradic current, regularly and frequently applied, will usually be found quite sufficient to procure all possible results. In the frequency of treatments lies the secret of success in electrical therapeusis with children. Tissue change is progressing with such wonderful rapidity that the influence of this, or of any form of force, is rapidly dissipated—thrown off from the changing economy. Two or even three times daily is not too often to apply the electrodes—and it will be found that, in a majority of cases, better results will thus be obtained than with fewer applications. It is important also to see that armature and platinum pin controlling the vibrations

are in a perfect state of cleanliness, or there will be occasional skips of current that are startling even to an adult and correspondingly aggravating to a little one, who is all wonder at the strange doctor or the strange instrument. More than half the success attained in treating children with electricity depends upon tact, patience, and care upon the part of the operator.

Pain is among children the leading disorder of sensation for which we are consulted, and is, setting one side disorders of digestion, usually in the head or legs. West, in his Lumleian lectures, says: "Pain in the head is almost invariably symptomatic of organic disease of the brain; in the legs with almost equal certainty of hip-joint disease." In point of fact, electrical treatment is, in my experience, never sought for infantile cerebral disorders, and they are therefore dismissed from our practical consideration. In many instances, however, I believe that it might very usefully supplement medicines and nursing, especially in those cases where the disease is accompanied by a high degree of nervous restlessness. And, as it is easily within the power of any general practitioner to try it, I advise the following method: At bedtime, after the child is prepared for the night, let its feet be placed in a basin of warm salt water, together with the negative pole of two Leclanche cells—the positive being attached to a large sponge also well wetted and applied to the vertex. Allow the current to flow ten minutes, or longer, until the child exhibits symptoms of sleepiness and quiet. This method is absolutely devoid of danger, and can scarcely fail to soothe excited nervous action, besides being easy of application.

But if pain in the head in children has never been submitted to me to treat electrically, the number of cases of pain in the legs has been very large. Nor can I agree with Dr. West as to its invariable origin in hip-joint disease.

In a list of twenty cases of this class treated during the past year, I have not found a single one where a rigid examination could detect any pain or tenderness over the acetabulum. They were all of spinal origin and yielded to treatment directed to that centre. When a child is submitted to expert examination for pain or lameness or loss of power in either or both legs, and these symptoms are usually common to each case, after the usual tests for temperature, state of reflex sensation, tendon reflexes and motility have been applied, electric search for location of the lesion is thus conducted. Using a faradic current strong enough to cause firm contraction of normal muscle fibre, which can be tested best upon the operator's thenar prominence, apply small button electrodes to each superficial muscle in turn. If they respond normally to electrical stimulus and are silent to the call of the will, there is small doubt that the lesion is beyond the nerve trunks, that it is central. If they fail to contract, the disease is excentric. Of course, this is speaking broadly and the statement is subject to exceptions; but for our practical purposes, it is correct and easily explained. If the nutritive nerve of the muscle under test is intact the organ will of course respond to electrical stimulus without reference to absence of central genesis of nervous energy, while if central cells are at fault, no amount of external irritation can supply the complete absence of motor supply. When we have thus

satisfied ourselves that the location of the lesion is in the cord, it is a most important point to know as nearly as may be in which section it is, and this may be determined in most cases by the following method: Using at least thirty cells of a low tension series, connect both poles with small carbon buttons, thoroughly wet. Place one firmly upon the sacrum, and draw the other towards it along the spinal column with enough pressure to ensure thorough contact. If there is any point in the cord where organic change has occurred it will be promptly designated by the patient upon the arrival there of the mobile electrode. There is a different sensation at such points—sometimes greater pain being complained of, sometimes almost complete anæsthesia, and I have grown accustomed, without any definite pathological reason, to connect increased sense of pain with congested conditions, decreased with anæmic or sclerosed states. And the other symptoms very generally coincide with such assumption. So, if upon reaching a point opposite the first lumbar vertebra, sudden sharp pain is complained of with a cry, which disappears as the downward sweep is continued past the second, I am in the habit of locating there an increase of blood or cerebro-spinal fluid, or both these—believing that only a predominance of conductivity of current can cause the sharply located pains beneath the electrode. And if upon continuing the examination with an æsthesiometer there is increased reflex sense over the gluteal region, the scrotum and the antero-external aspect of the thigh, there is little doubt that inflammatory action is going on in that portion of the cord which supplies energy to the first lumbar nerves.

For this method of mine in searching the cord for weak points, there is as yet no satisfactory demonstration upon the cadaver, so far as I am aware of, nor is it apparent how such a one could be made—but it is put into practical use many times daily at my rooms, and almost always with satisfactory results.

Care must be taken to explain to the patient who is old enough to comprehend, that the process is but momentary, and will hurt severely, for the current from thirty cells concentrated upon small electrodes burns sharply wherever it touches, and must not be stationary for a second.

And now let us take into consideration such disorders of motion in children as present themselves for electrical treatment. And more frequent than any other, first upon the short list, come convulsions. Of course the class of convulsive movements for which electricity is sought are exclusively those which "recur at uncertain intervals without obvious cause," and which have received the name of epilepsy. In a portion of these cases, where grave doubt exists if the cerebrum be the starting point, where there is no evidence, other than the spasms, of central disease, we usually find that both mental and physical development are retarded, and electricity is amply competent to increase the growth of the body, while acting beneficially upon the mind through elevation of general tone. For these cases, when the child is below five years of age, I find the faradic bath as previously described, the best form of application; when older, galvanism takes its place and must be used centrally alone, after the method described in Chapter II. Excellent results have been attained in epilepsy in

children, while the disease in adults has proven as refractory as in the presence of other remedies. The galvanic current employed must be of low tension, and a considerable number of cells may be used. I am at present treating a child of nine years of age for epilepsy, who bears without flinching a current from twenty-five cells between the cervical vertebræ and solar plexus, which few men could bear for a moment. Let the current be perfectly steady, the electrodes motionless and repeat the applications at least daily for several weeks. Sometimes it will be found advantageous to intermit all treatment during alternate weeks, if the skin becomes so sensitive that it cannot be borne without great pain.

Case I.—Ada V. G., age two years seven months. Father a robust Englishman with excellent family history, and mother an unhealthy Virginian, with consumptive history and diathesis. Six months before, the baby had been attacked with a cough while teething, followed in three or four weeks by convulsions, characterized by rigidity, inturned thumbs, bloody foam at mouth and deep sleep afterward. During the first twenty-four hours, four convulsions occurred. About ten days afterwards, baby began to fret in her sleep and have convulsions of the petit mal variety, which, however, did not appear during the day. When examined, electric muscular action was much impaired in thighs, and no current stimulus could produce the smallest contraction in the leg muscles. The child could neither walk, stand nor creep, and was scarcely sensible to any external impressions. The examination, which was made in November, was followed by spinal galvanization daily, with applica-

tions of the electric cautery once a month over the sacrum. In February of the following year, the convulsions had disappeared, sensation and motion had returned to the affected limbs and Mr. G. reported his child well. This occurred in 1879, and up to the present date there has been no return of convulsions and development has progressed evenly throughout the body.

Chorea or choreiform convulsions is next on our list of this class of diseases applying for electrical treatment. And I am bound to say, at the very beginning, that but a very few of my cases have received any benefit whatever from electricity. There are certain forms of the disease, where the symptoms are neither very severe nor very light, in which I have occasionally succeeded. But my experience leads me to believe that electricity is chiefly useful in removing the sense of fatigue that follows a long siege of uncontrollable muscular action, sometimes amounting to actual paralysis, or in treating the actual paralysis that occasionally comes after years of illness from this cause. Every form has in time been tried, and many months spent in fruitless work, until at present, I am sure to say to a choreic patient who comes with high hopes, that the chances for cure by electricity are so small that it is scarcely worth trying. If, however, such test is demanded, and vital action is in a generally depressed condition, I employ general faradization, and am of the opinion that little else need be tried. Nor have I been able to find many well-authenticated cases where more favorable results have been obtained.

Paralysis from various causes, most frequently

among the sequelæ of diphtheria or scarlet fever, are presented in considerable numbers for electrical treatment; and if we are nearly impotent in chorea, the reverse is true of paralysis, since in ten years but a single case has resulted unfavorably out of a list of more than a hundred. When the cause is either diphtheria or scarlet fever, and there is no constitutional taint, a favorable prognosis is always given. The treatment is general faradization and central galvanism combined, and it is only necessary to persevere long enough to procure excellent results. If, however, paralysis results from external injury, such as a concussion either of a nerve trunk or centre, the case is altered and rendered doubtful of prognosis, and the same remark applies to the essential paralysis of infancy. In all cases of infantile paralysis by sequence the electrical examination and treatment are conducted in the following manner: Each limb should be tested separately, as it often happens that but one of a group of muscles is affected, while the others remain intact. A few moments will suffice to determine the excentric nature of the affection by the method already described, and general faradization has procured the best general result in my hands. But it is by no means sufficient. Let each one of the impaired muscles be operated upon with a faradic current of sufficient strength to contract firmly a corresponding healthy organ for two or three minutes. This is best done by placing a flat sponge electrode, well moistened, at any indifferent point connected with the positive battery pole, and closing circuit with the negative, which should be a small button, over the point of entrance of the nerve into

the muscle, although it is unnecessary to be so accurate, as the second electrode may be placed at any point upon the muscle which will cause a contraction. Do not permit the tension of the muscle to remain complete, but, by interrupting the current at the screw-posts, or by any mechanical device, cause a series of waves to traverse it lengthwise, thus affording the greatest possible stimulant. It sometimes happens that no amount of faradic current that is bearable will call forth the smallest response, and electricity appears powerless. But, before concluding that this is certainly so, try galvanism, and, in many cases where the induced current fails, the constant will succeed. It is well to return, however, to the faradic machine as soon as possible, as the stimulant effect of its rapid vibrations are more profound and invigorating than galvanism; and to that end the impaired muscles should be tested frequently with the former, and the use of the latter abandoned as soon as the smallest response follows the test.

Naturally, cases of this kind are slow in the extreme, but it is wonderful what results patient continuance can produce. I do not call it a hopeless task to restore any muscle wherein I can obtain the smallest contraction with an interrupted galvanic current, although treatment may be prolonged for many months; but, where not a sign of response follows careful and repeated examination, I think the case may be considered hopeless.

CASE I.—Willie F. B., aged nine, native of Rhode Island; family history excellent. Willie was a healthy child until some four years ago, when he underwent a severe attack of typhoid fever, remain-

ing in bed ten weeks. Directly after recovery his parents noticed a certain difference in the legs, the left being considerably weaker, and were at that time advised by the family physician to consult a specialist, but deferred it, hoping that nature and time might prove sufficient. During the past year this weakness has steadily increased until, when he was placed under my charge, he could not walk upon a level surface without a marked limp, and cannot climb stairs at all without assisting the leg with a hand. Electrical examination gives complete loss of response in left rectus femoris and vastus internus. No loss of sensation nor difference in temperature. Left thigh three-fourths inch smaller than right. As the affected muscles absolutely refused to respond either to the induced or constant current, a bad prognosis was given, but the case was undertaken at the request of Dr. Carver, the attending physician, and the parent. After a month's daily application, I began to see a change in the manner of walking, but it was only slight, and no amount of perseverance effected more than temporary relief.

Marasmus and tabes mesenterica have both been successfully treated by general faradization alone, the former in a number of cases. As before observed, by far the best way of applying this treatment to young children and infants is the bath. For marasmus a continuance of electrical treatment for six months, making daily fifteen-minute applications, is usually none too long to accomplish a cure.

In tabes mesenterica much longer time will be needed, for we are subjected to many vexatious interruptions from diarrhœal attacks or other intercurrent

affections. It is always best to discontinue electricity when the bowels are loose, as their muscular action is thereby increased, occasionally to an alarming extent. But even in this intractable disease some brilliant results have been obtained in my hands by patience and care.

Incontinence of urine has been effectually treated by simple faradization of the genitals, and may be thus cured, I believe, in many cases where there is no organic central lesion. It is usually the result of insufficient nerve control, aggravated by habit and fear of punishment for soiling the clothing. Probably nothing relaxes the sphincters so suddenly and efficiently as fear, and before electrical treatment for this difficulty is commenced the child should be assured and convinced that it is not a fault nor a crime but a species of disease which can be cured. The treatment is conducted by placing a wide flat sponge electrode under the sacrum of the child lying comfortably, attached to either pole of the faradic machine, the other connected with a soft sponge the size of a large orange; using a very fine and even current, stroke the scrotum and inside of the thighs for five minutes, and then pressing the sponge firmly upon the pubis, continue for ten minutes longer. This should be repeated daily, better at night, and it will not be necessary, in a majority of cases, to continue more than a month to obtain a cure.

CASE I.—James B., aged 8, a healthy child of nervous family, had studied in public schools. For a year past Jimmie had wet the bed every night when he was not awakened two or three times, and for a month last past had wet his trousers in school. Genital

organs well developed, but the child was in a highly excited nervous condition, having evidently been scolded soundly and punished for what he was told was his fault. After a week's work to gain the child's confidence and convince him that he was sick, not naughty, I began treatment as above, and had the satisfaction of completing a cure in twenty-four applications. Two years have now passed without a single slip.

Loss of speech after fevers or in the course of violent attacks of chorea is occasionally met with, although cases are rare. When a reasonable length of time has passed for nature to assert her reparative force and no improvement is observed, electricity is clearly indicated and should be used as follows: Place one pole of a Flemming faradic machine over the fifth cervical vertebra, and slowly promenade the other, using an exceedingly mild and just perceptible current, over the sternum and on both sides of the larynx, observing that the throat muscles contract firmly. After ten minutes, change the neck electrode to one side of the larynx, with the other opposite, and permit the current to traverse the neck as near as may be through the vocal chord. If after a week's faithful work no benefit results, it is improbable that anything can be done and the case may be abandoned. Success in these cases is the exception. Young children never stammer.

This closes the list of children's diseases that are usually considered proper cases for electrical treatment, and although it has been fairly successful in cases of cholera-infantum, vomiting and in one case of capillary bronchitis, these must be, I think, re-

garded in the light of experiments, not yet worthy attention in this work, which is intended to cover only such points as have been demonstrated and are in daily practical use.

CHAPTER XI.

DISEASES OF THE BLADDER, PROSTATIC ENLARGEMENT, ETC.

Diseases of the bladder that have been successfully treated with electricity are cystitis, acute and chronic, paralysis, and spasm dependent upon gouty conditions, hysteria or excessive venery. Acute cystitis comes to the specialist when pain can scarcely be longer borne and the patient has heard from friends or his physician advises that electricity is useful in such cases. Besides pain, there is generally acute tenesmus and a heavy feeling above the pubes, as of a weight pressing downward inside the bladder. I have been successful in relieving the symptoms of pain and tenesmus in several cases by the following method: Place the patient recumbent, a flat sponge electrode under the sacrum, and a large carbon electrode just over the pubic arch. Through the tissues thus in circuit, cause a current from twenty low tension cells to pass steadily for ten minutes. If the patient is a male, change the carbon plate to the perineum and continue the treatment fifteen minutes longer, gradually lessening the number of cells to zero. If a female, exchange the sacral sponge, after the initial ten minutes, for a vaginal ball electrode, covered with wash leather, and proceed as before. It is surprising how quickly pain has vanished and tenesmus

lessened under this treatment in these cases. In the acute form I have regarded it as unsafe to apply the current to the membrane of the bladder direct, as the tendency of so powerful a stimulant would probably be toward increasing irritation. But in the chronic form, when acute symptoms have subsided and there only remains a dull sense of suprapubic weight, frequent calls to micturate and in elderly persons a certain amount of paralysis, I have obtained best results from internal treatment thus conducted. The bladder being injected full of warm salt water, an olive-tipped bougie, insulated up to the bulb, is introduced until the tip is freely movable in every direction. It should be so handled that the tip should be as near as possible to the centre of the distended organ. Then, placing one sponge pad under the lumbar region and another over the pubic arch, connect them both with the positive pole of a low tension battery by means of a double cord. The intravesical electrode should be connected with the negative battery pole, and the current added cell by cell until an agreeable warmth is perceived in the bladder. More than ten cells is unadvisable, as it is necessary to avoid all danger of cauterizing the membrane lining the organ by accidental contact with the tip. In aggravated cases the current may be allowed to act for forty or fifty minutes at a sitting, which should be repeated twice weekly. It will not be needful to continue treatment for a longer time than two months, which period usually suffices to cure most cases.

CASE I.—C. T. F., aged forty-three, bookkeeper and manager of a large oil business, came to my office in November 1881, suffering with acute abdominal pain

and severe tenesmus. Three days before he had been wet through in a rain storm and could not get dry clothing for two hours, thus contracting a severe cold. The same night he experienced pain in the bladder and glans penis, which rapidly increased, with some fever and general restlessness, until finally, growing impatient of slow relief from medicines, he sought the aid of electrical treatment. Pulse ninety-five, quick and hard. A hasty examination of the urine gave large deposit of ropy mucus and quantities of amorphous urates. Treatment as above indicated was at once begun, and after a thirty minutes sitting he went home much better. Another dose was administered the same night at his house, and he slept quietly all night. For four days two treatments daily were given, when he was dismissed, greatly improved, for medicine and care to finish the work.

CASE II.—Mrs. S., a feeble, emaciated old woman, at least eighty years of age, farmer's wife, came in from the country and placed herself under my charge last May. She was suffering extremely from chronic cystitis, with frequent micturition, great suprapubic pain and general prostration. The endoscope gave thickened, roughened membrane of a dark brick color, feeling like leather as the tip of the instrument touched it. The bladder was injected full of warm salt water, holding fourteen ounces, and ten cells of a permanent battery employed in administering galvanism as above described. The feeling of comfort and rest was so great, that the current was allowed to flow for an hour, during which time the old lady took repeated short naps. She came three times weekly for a month, and seemed to gain fairly well; but her

general health was too poor to admit of her continuing the ten mile drive each way from her home to my rooms and she gave up treatment. I particularly regretted losing this case, since it was a typical one of its class, and under more favorable circumstances would have made an excellent test.

Enlargement of the prostate gland is an exceedingly common affection among men between fifty-five and sixty-five years of age. It is an annoying disease, accompanied by aching pain in the perineum, a desire for frequent micturition, and in the later stages considerable cystic disturbance from retained urine, which speedily becomes ammoniacal. Sir Henry Thompson, in his latest paper upon this hypertrophy, limits its appearance to the five years between fifty-eight and sixty-three, but in this country at least we need a somewhat wider margin.

In a majority of cases, treatment must be employed with a twofold aim : to obviate the consequences of obstruction caused by the enlarged gland, and to attack the hypertrophied organ direct. It may be said that the former is included in the latter, but such is not always the case. Steady approximation of the sides of the urethra with some amount of pressure for a long time, results in a narrowing of the canal itself without reference to its occlusion by an impinging mass, a veritable stricture, for which relief is often sought. By means of electrolysis, to be fully described later, this condition is ordinarily curable, and micturition becomes free as soon as the pressure is relieved. When, however, from general laxity of perineal tissues, which condition frequently obtains in old men, the whole contents of the pelvis sag

downward, relief is usually sought from the painful symptoms of pressure and cystitis, rather than from actual stoppage of urine, and treatment for this, to be effective, must be long and tedious. But if protracted, it is the only remedy which has proven effective so far as I know, and is readily applied by a general practitioner. Let us consider the *modus operandi*. Taking the precaution to have the rectum thoroughly emptied, introduce a ball electrode half an inch in diameter, covered with wash leather and well anointed, up until it presses firmly upon the enlargement and have the patient steady it there. Introduce an insulated bougie as far up as the prostatic urethra and connect it with the negative pole of a low tension battery, attaching the other to the positive screw post. Commencing at zero, increase current gradually and carefully, cell by cell, until a gentle sensation is perceived, the number of cells on no account to exceed six, or two milliamperes. Permit the current to flow for thirty minutes, unless pain be complained of or a distinct sense of burning, in either of which cases diminish the force promptly. Remove the urethral electrode and substitute therefor a sponge pad connected with the negative pole also, and place under the sacrum. Reverse polarity half a dozen times with the switch on the keyboard, and the sitting is finished. Care should be taken at the outset to inform the patient that any treatment to be effectual must be long and steady, and it is my habit to mention a year as the probable length of time necessary to prepare for. Sittings which include both rectum and urethra should not be made oftener than once a week, on account of the danger of perforating the rectum—the

other with the sponge should be made daily at least. After a distinct lessening is observed in the bulk of the gland, it is better to discontinue the urethral electrode altogether and pursue the treatment with the negative pole pressed firmly over the pubic arch, thus reaching the bladder as well. When this point is attained, I have found it advantageous to alternate faradization with the galvanic current, making the circuit between the subsacral and suprapubic points, without regard to current direction.

Case I.—C. W. F., physician, aged fifty-eight, unmarried. Dr. F. applied for electrical treatment after having suffered acutely from all the usual symptoms of prostatic hypertrophy for a year, without any interruption to micturition, but with the addition of a great deal of painful priapism. Erections came on every night or nearly so, shortly after retiring, and continued through the greater part of the night, seriously interfering with sleep. Patient weak and anæmic, but without any declared disease. As the nerves which supply the prostate are branches of the hypogastric plexus of the sympathetic, and as hypertrophy was ascertained upon examination to be confined to the middle lobe and of no great magnitude, electrical treatment was directed from the solar plexus to perineum, employing descending galvanism from twelve cells for twenty minutes—then a faradic current between the same points, merely changing cord tips from one keyboard to the other, for twenty more. The result was particularly comfortable. After the first application, Dr. F. had a good night's rest, being hardly troubled at all by erections, and they have been scarcely no-

ticed since. He attended daily for a month, and stopped, feeling quite well. When the gland begins to become seriously troublesome from enlargement, I shall treat it as above indicated—probably in about two years.

CASE II. J. G. S., merchant, aged sixty, vigorous and of fine physique, came under my care in 1881. He had been suffering for some time with a slight dribbling of urine, and had noticed, that no matter how completely he had seemed to empty the bladder, there would be a few drops afterward—enough to wet his shirt unpleasantly. A comfortable stool had been unknown for some months past, there being a sense of obstruction. Patient was much alarmed, fearing paralysis, from which two of his family had died. A careful examination eliminated all symptoms of nerve lesion, and an examination per rectum revealed a hypertrophied condition of the prostate so advanced that its rounded form showed through the perineal fasciæ. After a thorough explanation and understanding, treatment was begun after the method above described, and continued seventeen months, with occasional intermissions for a vacation for both doctor and patient. At the expiration of that time, all external signs having disappeared, a rectal exploration was made, and the hypertrophy had so nearly disappeared that a trace only of enlargement was found in the middle lobe.

Such results as this must necessarily be rare, for it is next to impossible to persuade patients to embark upon a course of treatment involving daily attendance for a year or more, and practically quite impossible to induce them to continue once improvement is ex-

perienced. They grow very tired and quit. There are occasional exceptions, and Mr. S. was one of them. Paralytic conditions of the rectum and its sphincter, together with internal hemorrhoids, frequently come under treatment. Lack of tone in muscular coat of the rectum, permitting prolapsus, and that form of atony wherein the bowel loses its expulsive power, are the most common. The former condition is usually found in strumous subjects, and under ordinary treatment is difficult of cure. This is especially the case when the protruded portion is of considerable size and has remained outside the sphincter for some time, becoming indurated, fissured or ulcerated. There is difficulty even in replacing the bowel, let alone keeping it in place. The proper current in these cases is faradic, which may be employed of considerable strength, as the rectal supply of sensory nerves is small. The electrodes used for this purpose are two—a metal ball half an inch in diameter attached to a stout curved wire a foot long, well insulated. A very good way to do this is to have the ball made to screw on the rod, and, before attaching them, slip over the wire a cheap gum catheter. And, by the way, this is a good plan of insulating any wire used in electrical work. Nothing found in the costly appliances of instrument makers can equal devices arranged by an ingenious brain to fit each sudden want at an infinitesimal cost, and there are very few pieces of apparatus which cannot be made or at all events something just as good, in any home laboratory. The second electrode may be a large olive tip of metal about two inches long by one-third of an inch thick, tapering to a blunt point and attached to a shorter in-

sulated wire. After replacing the protrusion, introduce the ball electrode up as near as possible to the sigmoid flexure and connect it with either pole of a faradic machine. Patient recumbent, place a small sponge, well moistened and connected with the other pole, firmly against the perineum. Give fifteen minutes of as strong current as can be borne in this manner, when the patient will usually feel a distinct lifting up of the whole rectum, as well as a sense of constriction. Then exchange the ball for a tapering electrode, the sponge at the perineum for a pad under the sacrum, and proceed as before—only the metal electrode should lie just inside the sphincter. It will be sufficient to repeat these applications every two days, meantime retaining the protrusion in place by a perineal pad, and keeping the bowels thoroughly soluble. A month has usually been long enough to conquer the most obstinate case, and half that time is sufficient for mild ones.

In atonic cases, accompanied with fecal retention, the same method is followed, using the tapering-electrode only. Here prognosis is worse—as the condition usually accompanies extreme debility from organic change.

CASE I.—W. B., merchant, aged forty, of highly nervous temperament inclined toward hysteria, who had been under my charge several times for neurasthenia, came in one morning a year ago, complaining of obstinate constipation. "One good stool," he said, "would be worth a hundred dollars." An examination gave slight prolapsus from straining, a brilliantly red gut, so much of it as was visible, and an empty rectum, although Mr. B. assured me that he had not

had an evacuation for two days, had eaten heartily and did not feel any symptoms of indigestion. Treatment was begun as above, and in twenty minutes the patient went to the closet and enjoyed a comfortable, copious defecation. Three subsequent applications were made, and there has thus far been no return of the difficulty. It is surprising how suddenly a motion of the bowels is occasionally produced by this method.

Internal hemorrhoids are best treated with galvanism.

The peculiar astringent action of acids set free at the positive pole of the battery where it comes in contact with tissues is particularly well adapted to treatment of these troublesome difficulties. As it is a species of electrolysis that we shall employ for internal hemorrhoids, a few directions as to battery technique for that process will perhaps be in place. Before using a galvanic battery for electrolysis, no matter how slight, no matter if internal or external, the positive and negative poles must be accurately and instantly known—must be in fact as familiar in difference to both eye and touch as are the surgeon's scalpel and artery forceps, for there are times when a mistake as to this point would be exceedingly unpleasant. Bearing in mind that a crossed circuit may reverse polarity of a battery at any moment of absence therefrom, I always test for it. Long experience has made difference of taste between the poles a sure method, but more agreeable and equally certain is the litmus test. Wet a strip of litmus paper in pure water, attach two conducting cords to the screw posts of the battery, and place the loose tips side by side on the paper half an inch apart. In a

moment, the paper will turn red under the positive pole from liberation of acid, and remain unchanged under the negative, alkaline end of the circuit. Then tie a bit of white cloth on the positive cord and there can be no mistake. I am well aware that this digression is out of place here, but as the negative current would be useless in hemorrhoids and the positive will often cure them, it is better to be absolutely sure before beginning.

With patient in a convenient position introduce the rectal olive tip before spoken of up to the hemorrhoids, whose exact location should be previously ascertained by examination. This point is of great importance. It will not do to go shooting around in the dark with electricity for a diseased mucous patch or swollen mass of hemorrhoidal veins, any more than with any other form of astringent local application which is of a caustic nature. When the mass is located, insulate the side of the metal electrode away from it with a single coat of collodion—more will impede its entrance into the rectum and place the naked part in contact with the inflamed surface. Connect this electrode with the positive battery pole and negative with a chamois-covered carbon point, which may be held in the hand or placed upon any indifferent point. Switch on battery, cell by cell, until the rectal burning becomes painful to some degree, and continue it for fifteen minutes. This application should be repeated every third day, and eight or ten have usually proven sufficient either to effect a cure or to exhibit failure of the remedy.

Case I.—Miss A. C. L., aged twenty-six, a slender, well-formed brunette, was placed under my care sev-

eral years ago for difficult and bleeding internal piles which no previous treatment had succeeded in relieving. There was constant pain, not particularly aggravated by defecation, a streak of blood occasionally and then a sharp hemorrhage — say two or three ounces. A careful tactile search failed to find the source of bleeding, and we were obliged to rupture the sphincter before it was discovered. A mass of rectal veins the size of a silver quarter of a dollar was then exposed with the speculum, and gently electrolysed after the above plan, while the bowels were kept soluble by relaxants. After a month of biweekly applications of this kind, she reported herself well, and a present student, to whom she has become known, reports that she is well at the present writing.

I am induced to consider these rectal and prostatic affections at considerable length, as I am aware of no other author upon electricity who has done more than give them a passing mention, and as I regard them of the greatest importance. Indeed, if there is any other treatment whatever that has been effective in reducing a hypertrophied prostate it has escaped my notice; and the subject is of sufficient importance to demand, it seems to me, as much care as any other.

In diseases of heart and lungs, the aid of electricity is much less frequently invoked than in diseases peculiarly appertaining to the nervous system. I have, however, employed galvanism as an aid in controlling the spasmodic paroxysms of whooping-cough, with marked success. It should be used in connection with general faradization as a tonic, and my best results have been obtained in recent acute cases. Large soft sponge electrodes should be employed with

a current just strong enough to be felt, the sitting prolonged until slight fatigue is complained of, and repeated daily. The best time of day for all these applications is evening, when absence of the usual irritating addenda of the day gives the wonderful soothing effect of galvanism full play.

Case I.—Mary B. J., aged twelve, robust, well-nourished child, good family history. In the fall of 1880 I was consulted by the child's mother, a widow, who wished me to try what electricity would do for her child, who had a severe attack of whooping-cough. Arriving at the house I found that a notorious quack had been treating the child with hot drinks and the cold pack. After some difficulty in getting rid of him, I began central galvanism and general faradization, the former in the morning and the latter at night, with very excellent effect. Each electrical treatment was followed by a quieted condition, much less spasmodic action of the chest muscles and lower note of the whoop. Although I do not think that electricity had any effect in shortening the period of duration of the disease, there was certainly a very considerable amount of lessening of spasm and nervousness. After the second day, the little girl asked anxiously for my coming and was reluctant to have the application stopped.

In asthma of the spasmodic type, the best results have been secured by central and pneumogastric galvanization. In early stages of the disease, I am convinced by my own experience, as well as by the results obtained by Beard and Rockwell, Althaus and others, that a cure is possible. Central should be alternated with pneumogastric treatment, one of each in

daily applications, and the latter is thus practised. With the patient comfortably seated with bared chest, the negative pole of a low tension battery is connected with a large sponge electrode, which is to be firmly pressed over the solar plexus. With a small metal bar, one inch long by one-eighth wide, covered with wash leather, well moistened and connected with the positive pole, make gentle pressure over the nerve in the jugular fossa, switch on very slowly enough current to cause a slight sensation of burning, and continue for ten minutes. Then change the positive electrode to the supraclavicular portion of the nerve, just where it dips into the chest, and repeat for another ten minutes. By this time the skin under the negative pole should be well reddened and the sitting is over. The chief obstacle to electrical treatment in asthma is the patient; for, while each attack is relieved and sometimes quite cut short by the current, this is no guaranty against its recurrence—no amount of time having proven sufficient in my hands to cure an inveterate chronic case. When the case is recent and in a young subject, the chances are better, and good work has been done.

Case I.—S. T., aged sixty-four, retired merchant of hereditary asthmatic history, father having died in a paroxysm of the disease. Disease made its appearance in a spasmodic form at an early age, the attacks being frequent up to fourteen years of age, when they intermitted until twenty-nine. Again beginning they continued at intervals of about six months up to forty-five, when another rest occurred. About five or six years ago another paroxysm took place which only partially relaxed and soon became

continuous, growing worse with hot weather and accompanied with profuse post-nasal catarrh. Has never tried a change of climate, although quite able to do so. About a year ago began to lose flesh, then sleep became poor, without any special lassitude, digestive derangements followed, attended with eructation of immense quantities of gas. The spasms of asthma were very severe, and he anticipated dying in one of them. Under the skilful treatment of Dr. Carr of this city, some relief was experienced, but nothing continuous or marked. Is in a high state of nervous excitement, with neurasthenic topophobia. Starts in sleep and passes considerable time in a semi-conscious state. Memory rapidly failing. Ophthalmoscope gives double optic neuritis with anæmic retina and choroid.

It will be seen that a more unpromising case could scarcely be selected as an illustration than Mr. T. Treatment was commenced on the 17th of April, 1880, and continued for two months, as above indicated, with very considerable improvement. The paroxysms grew shorter and less severe, and the patient became able to take some interest in life once more. At this time, however, unfortunately, he became embarrassed in circumstances, and was obliged to suspend, having gained as much in that period as could possibly have been expected. I have not seen him since.

CHAPTER XII.

ELECTRICITY AS A SEDATIVE.

WHOEVER asserts that electricity is simply a stimulant, can have had but small experience of its wonderful effects as a sedative. Besides its vitalizing influence, which is of the nature of a restorative rather than a stimulant, it possesses a quality as directly opposed thereto as the excitant effect of a small dose of opium is opposite to the narcotic effect of a larger one. In acute diseases, especially those of closed cavities of the body, this sedative action is readily produced, and is of the highest beneficial influence. Such a statement may seem paradoxical, when the nature of the force is or seems to be directly in the line of an increase of irritation of nerves rather than that of toning them down. But such a view would be as superficial and as little permanent as the erythism which a galvanic sponge produces upon the skin. It is, however, necessary that special currents, or rather faradic currents possessing especial qualities of fineness, evenness and softness be employed through sponges covering wide areas of the body, if sedative effects of electricity are to be attained. Galvanism applied to acute cases for this purpose has in my hands proven a failure, except as an adjunct to faradism. Its general effect is at all times devoid of the especial sedation which comes after a gen-

eral faradization conducted for this especial end, and I have abandoned it. The ideal inductive coil for sedative effects is that of Du Bois Reymond, whose action is in many ways the reverse of the ordinary faradic instrument. The inner or inducing wire is of much greater comparative size and the current much milder in tension, becoming almost nil to tactile sense when firmly pressed upon the surface, although its sharpness may be nearly unbearable when lightly applied. It is no longer necessary to send abroad for these coils, as they are made in perfection by Flemming of Philadelphia at a very moderate cost. Since, however, these papers are chiefly for the general practitioner, whose one faradic machine must do all the induced current work, I hasten to add that excellent results have been obtained by the machine indicated as the best in Chapter I of this book. Fineness of current, *i. e.*, such rapid vibrations of the armature as to be beyond count and to give to the thenar muscles when applied there a sense of steady continuous stream, is the first essential. To have a "steady by jerks" current would be conducive to anything rather than sedation, and the sensation of a succession of blows, so necessary in some cases, is certain to defeat the object now. If the machine is unruly and objects to give the needed fineness, screw down the point against the vibrating bar until it barely moves; if this fails move the bar in its slot along the set screw until the platina point is one-half closer the free end than before, and it will be found that a combination of these manœuvres will obtain the desired result. If as steady a flow as is wished cannot be obtained, the next best must do, but there is not often any

trouble in this direction if proper instruments have been selected. Evenness of current is the second desideratum. If the strength varies from a distinct sensation to nil and back again, the patient's nerves are kept on the alert, wondering what is coming next; for the most experienced of clients can never quite divest himself of the idea that a shock is liable to come at any time,—another impediment to sedation. Causes of this variation are a run-down battery and oxidization of the armature point or platinum plate upon which it impinges. After a Grenet cell has been left for a few days inactive, or has been pushed hard for a week, the carbons get saturated with acid, fluid becomes disorganized and a varying supply of energy is the result. Half an hour of action will suffice to encrust platinum point and disc so that no amount of battery current can pass evenly, and an uncomfortable sensation of jerkiness is the direct result. There is but one remedy. Whenever sedative applications are to be made, the cell should be newly charged, carbon plates soaked out and dried, and armature points scrupulously cleaned. In my laboratory, double sets of plates are employed to be used on alternate days, idle ones meanwhile soaking out in alkaline water to be ready for their turn. But if the general practitioner will be careful to take out his carbons from the fluid and rinse them off when he is done using the machine, and give platinum surfaces a polish each time, he will have no trouble from this source, unless the fluid is too old. Ten days standing frequently spoils it. By softness of current is meant that quality which can be best described in negative, as the one which does not produce

a burning sensation when applied to the skin. In fact, the sensation should be one of grateful coolness than the reverse. A harsh current is either the result of too intense primary battery power or too slow vibrations of armature; but as the instruments previously recommended are not liable to those difficulties, I shall not occupy further time with them.

Diseases of the chest that have been treated by me by electricity are capillary bronchitis, acute phthisis, pneumonia, valvular heart lesions, functional derangement of the heart, angina pectoris, intercostal neuralgia, pleurodynia and hiccough.

Diseases of the abdominal cavity which have been cared for are intestinal dyspepsia, chronic gastritis, constipation, obstructions of the bowels, rectal stricture, jaundice and peritonitis.

With the exception of valvular heart lesions and hiccough, there is no difference in the manner of application for them all, and the following plan is equally applicable to each of these diseases. The greatest quiet possible should be enforced during a sitting, and as there are few noises more annoying to a sick person than the buzzing sound of the armature, I am in the habit of placing the instrument in another room, far enough away to prevent it from being heard, leading the current therefrom by long flexible covered wires. It is an excellent plan, by the way, to keep on hand a dozen yards or so of two wire flexible cable, which is made in perfection by Mr. Eugene Phillips of this city. It will be found useful in many cases such as this, occupies no great space and costs but a few cents. With a flat sponge electrode connected with one pole slipped under the nape of the patient's neck, a

folded towel under it to protect from wet, uncover the chest half at a time, and, using a large, soft sponge, well wetted with plain hot water, for the other pole, begin from above downward with long, slow strokes. After two or three minutes, dry and cover this portion of the surface, move the sponge pad a few inches downward and repeat upon the other side. Six to ten minutes is quite long enough for these applications, and the current direction is of no possible consequence. The technique in angina pectoris and intercostal neuralgia has already been described under the head of neuralgia, and there remains to consider valvular heart disease and hiccough. The part played by electricity in structural changes in the cardiac valves is twofold; it increases the general tone of the system by adding to its vitality by general faradization, and it abates the pain and slow action arising from inordinate irritability of the organ by local galvanization. General faradization has already been described, and is now familiar to every one who owns an instrument, and the only difference I have to recommend from the usual plan is to use the hand as an electrode in place of a sponge. It is much more pleasant to the patient, and the operator can recognize any irregularity of battery as quickly, sometimes even before the sick person can. It is only necessary to add that all currents in serious cases must be very mild. It will not do to be guided by the patient's sensations in any way, and if the operator can feel distinctly the passage of the current, it is quite sufficient. Application of galvanism to the heart is thus conducted: Attach the positive pole of a low tension battery to a short well-wetted bar electrode, and press it deeply into the fossa behind the

ear so as to reach as closely as possible the superior sympathetic ganglion, origin of the superior cardiac nerve. Connect the negative pole with a large, soft sponge and switch on, cell by cell, a current of at least fifteen elements, making firm pressure all the time over the apex of the heart. After ten minutes, gradually diminish the current to six cells, and sweep the negative sponge slowly over the cardiac thorax, taking care not to break circuit by removing the sponges altogether. Continue this motion for ten minutes longer and the sitting may be closed. I have found daily applications essential to success, and at least three months' treatment necessary for relief. The main points to be looked out for in cardiac galvanism are over-stimulation by too strong applications or too long sittings. If the current is too strong, it will be promptly shown by the pulse, which takes on dicrotism and begins to fail in force. This, of course, must be carefully watched and current strength promptly lessened. Faintness and extreme pallor, indicating exhaustion from over-stimulus, follow the pulse sinking, and only appear as the result of carelessness. Precisely the same symptoms arise from too prolonged sittings, and the aphorism recited in the first chapter may be appropriately reiterated here—never tire a patient and never hurt one. Favorable symptoms to be anticipated are decrease in tumultuous or irregular action, increase in pulse strength and evenness, and an indescribable sense of comfort over the whole system, which arises from the vitalizing power of the current.

Case I.—C. S., aged sixty-five, sea-captain, six feet tall and weighing probably 150 pounds, applied

for relief from excessive chest pain, with dyspnœa and inability to sleep except in a sitting posture. Feet and legs beginning to swell, and aspect cadaverous and anxious. Auscultation gave a loud regurgitant aortic murmur and some rough sounds on right side. Patient had been compelled to give up business some eighteen months before.

Treatment was commenced with general faradization, daily applications, using extreme care over the cardiac region, as any sharpness of current was followed by faintness. The only medicine employed was lily of the valley tincture in six-drop doses. After five days faradization, his status improved so that for the first time in months he was able to lie down. Cardiac galvanization was then substituted, and immediate improvement of all symptoms soon became apparent. Rosy tints appeared in lips and finger tips, which had been of a cyanotic blue, and rest was once more tolerably comfortable. The captain then discontinued treatment, feeling satisfied with his gain, knowing that a cure was out of the question.

Hiccough is one of the most distressing symptoms of many forms of hysterical diseases, as well as those of an æsthenic type, and occasionally advances to the dignity of a separate disease, in either instance frequently proving refractory to all medication. I recall with remarkable vividness the first case of this disease or of this symptom wherein I used electricity. It was in Minneapolis about fifteen years ago, and the patient was the wife of a leading physi ian, herself a woman of rare attractions and a general favorite in society. She had been suffering for several days with what finally declared itself to be

obstructed bowel, and her strength was failing, when an exhausting and obstinate hiccough set in. The only instrument I possessed at the time was a clumsy old sulphate of copper cell and home-made induction coil, which was, however, the only one in the city, and I suggested to the consulting physician its application. With anxious heart and careful fingers I adjusted the electrodes, immersed the zinc, started the armature, and watched for developments. The room was almost dark; the daughters of the sick woman and her husband, as well as the doctors, listened carefully to the buzz of the armature, and counted, watch in hand, the recurring spasmodic contractions of the diaphragm. As I increased the current strength until the intercostal muscles began to quiver, spasms grew less frequent, and in twenty minutes had ceased, and from then until her death, twenty-four hours later, there was no more hiccough. Since that time I have been summoned in many cases of this painful condition, and have almost invariably been able to relieve it. Slight cases are checked in a few seconds, and few resist longer than twenty or twenty-five minutes. The method of application is as follows: One pole of a Flemming induction coil is to be attached to a round sponge electrode, say one and a half inches in diameter, which is placed over the axillary plexus, firm pressure being made by bringing the arm down to the side and holding it there. Place the patient in a sitting posture, stripped to the waist, and, using a large moistened sponge for the other pole, commence making slow stroking passes over the intercostal spaces on both sides extending around the trunk.

The current should be mild at first, gradually increased in strength until the intercostal muscles plainly contract, unless pain becomes too great to bear before that point is reached. Of course, the room must be warm and care taken to avoid a chill. In several cases, where an erect posture was not an easy one to take or maintain, I have simply passed the current from one pole to the other around the trunk, but without as much success. Galvanism has also received a fair essay, but the results were so incomparably inferior to those from the induced current that it was abandoned.

Intestinal dyspepsia is generally associated with, frequently a direct result of, atony. In those cases accompanied with pain in the lower abdomen coming on an hour or two after meals, with general depression of spirits and constipation, progressing until all of life is dark and there is no longer any comfort in existence, drugs frequently fail, even when accompanied by the most rigid diet list. Here electricity plays a strong part, and is the surest source of relief. As chronic constipation occasionally accompanies this atonic condition of the colon and rectum, it may be fairly discussed at the same time. No age exempts from its attacks, and I have been unable to discover any disparity in numbers of cases between the sexes of late years. The notion that obtained among fashionable ladies a few years ago that, while it was quite correct and proper for gentlemen to speak of having bowels and of their functions, ladies should be ashamed of anything of the kind, has given place to sounder and more sanitary ideas. To-day a young lady will speak as frankly and modestly of her bowels

and their condition as a man, and, the better bred she is, the more plainly she will speak, if the necessity exists. The result of this improvement in morals is that women no longer go for days without an evacuation, simply because they are too modest to seek a closet, and the conditions are better balanced. Faulty diet even in early years is a fertile cause of this disordered condition. A few days ago a child was brought into my rooms, pale, of a dark bronzed color, jaundiced eyes and foul tongue, whose mother stated that the boy's bowels rarely moved oftener than once a week, and then only after a cathartic. "What do you give him to eat, madam?" "Why, doctor, he has just what the others do." "Do you give him tea and coffee?" "Oh! yes; only he doesn't care for tea, and we give him coffee three times a day." "Do you eat much pork and pastry?" "Yes, sir; every day something of the kind." And this was the sort of food that a five-year-old boy existed upon, and then complained of constipation. Nor could I prevail upon the mother to attempt a change. She declared that it was too much trouble to be fussing about the child's food; that she had heard electricity praised in constipation, and wanted to try it. Of course, I declined so doubtful a case, and the boy is probably in the same condition yet. Electricity in both these conditions is best administered as follows: Galvanism of the cord, as previously described, should alternate with faradization, or the two currents given at the same sitting, dividing the time between them. Rectal faradism is thus applied: With the patient recumbent and the rectum thoroughly washed out, introduce a rectal electrode well

up to the sigmoid flexure. It must be of such size that a fair amount of mucous surface will be reached at once, of somewhat an olive shape, for convenience in entering the anus, and of polished metal, with a hard rubber stem. Connect this with either pole of a faradic machine, and the other with a sponge electrode large enough to cover at least six inches square of abdominal surface. The object of such a large size is to diffuse the entering or departing current over enough space to avoid violent muscle contractions or severe pain. With as fine a current as possible, commence with the first switch of the induction machine and draw out the helix as sensibility to the force diminishes, which occurs very soon in the rectum. Increase switch by switch until the limit of amount of tension that can be borne without pain is reached, and at once stop. Then, with a small button electrode pressed against the perineum, continue the sitting until twenty minutes in all have been expended, unless a desire to defecate comes on sooner. Sittings must be repeated daily, and the greatest care taken that the internal current be not strong enough to be in the least painful, nor be prolonged more than five minutes. By neglecting this precaution, or rather in ignorance of it, I succeeded in producing in two cases a violent enteritis, and those patients with their friends have disapproved of electricity in medicine ever since.

Case I.—Miss F. W., aged twenty, a well-developed blonde, came under treatment in January, 1884, suffering with chronic constipation, for which all remedies had been tried in vain. A sensible girl, she was ready to do anything that promised cure, and

treatment was begun as above. The second application produced a copious stool within an hour, and after twenty more visits she reported that everything was regular and was dismissed. At a recent visit from Miss W., December, 1886, she told me that her bowels had remained effectively regular ever since.

Chronic gastritis, that form of stomach irritation when there is epigastric tenderness, eructation of gas some hours after eating and pain upon ingestion of food, has been treated by electricity with fair success. Its use is indicated when other remedies, including a rigid diet list, have failed, when the patient is excessively nervous, and especially when insomnia is a leading symptom. The form to be used is galvanism, and I employ it in the following way. It should be said in passing that precisely a similar proceeding is recommended in jaundice and peritonitis. The patient recumbent, a large flat sponge electrode is placed under the cervical vertebræ connected with the negative pole of a low-tension galvanic battery, and the positive connected with a soft sponge-holder the size of a large orange. Just enough current should be switched on to be distinctly felt as a burning sensation on the skin, and in gastritis, held stable over the pyloric stomach ; in jaundice, pressed up under the lower lobe of the liver, and in peritonitis, promenaded gently over the entire inflamed surface. Both sponges must be kept warm, and a small surface only treated at a time. Effects to be looked for at first are increased flow of gastric juice, diminished pain and eructation, and disappearance of soreness upon person. Sleep follows as a matter of course. In jaundice it is well to add to the con-

stant flow through liver and gall-bladder a succession of shocks by reversing battery polarity sharply—voltaic alternatives—and an increase in bilious stools will soon be apparent. There is no more direct nor better cholagogue than galvanism properly applied. In peritonitis, application of the continuous current is followed by a lessening of pain, lowering of temperature, and general sedation. I have suggested its use in place of topical irritants, such as blisters, etc., and in the single case I have tried it, here quoted, with good success.

Case I.—G. N. W., aged thirty-two, formerly a butcher. About five years Mr. W. suffered an attack of acute dyspepsia, after which chronic gastritis came on, which has persisted until the present time, in spite of treatment from first-class practitioners. He suffered extremely from pain after eating, and a sense of deep soreness in epigastric region, aggravated at times by so slight a pressure as the clothing. Has spent a winter in Southern Colorado with considerable benefit, but the disease recurred upon his return East. No change in diet was required, as it was already correct. Patient was at once placed upon treatment with the constant current, as above described, with most excellent results, and at this date, December 10th, 1886, has not reported for more—an excellent sign.

Case II.—Mr. F. M., aged thirty-five, vigorous blonde, was attacked with enteric pain and tenderness, directly following a course of electrical treatment for chronic constipation at my hands, and I followed the case with much interest. When peritoneal inflammation was fully established and tympanitis well marked, I began galvanic applications as above

described, with the view of replacing vesication. They were made morning and evening, twenty-five minutes each sitting, and the result was excellent. The skin was left thoroughly reddened, and no other counter-irritation was practised throughout the case, which resulted favorably. Besides the local effect, there was apparent a general nervous sedation, which was pleasant in the extreme, and which obviated the use of narcotics to some extent.

In obstruction of the bowels with supposed invagination, electricity has been employed with occasional good results. In my own hands it has been employed but once, and that unsuccessfully. But the rationale of the abdominal use of electricity——causing waves of muscle contraction to traverse the abdomen, throwing the intestines into vermicular motion—is thoroughly sound, and no case should be submitted to the knife until a thorough and skilled trial of faradism has been made. The method is as follows: With the rectal electrode in position, connected with the negative pole of a faradic machine, supposing the invagination to be at the ileo-cœcal valve, attach the positive to a small sponge conductor, press it firmly down toward the seat of difficulty, and switch on as strong a current as can possibly be borne. As the object is to produce a series of rhythmic contractions, the current should be intermitted at intervals of five seconds and given staccato. Half an hour will settle the matter as far as electricity is concerned, and if no good results, no harm is done, which is more than can always be said of treatment by the knife.

CHAPTER XIII.

DISEASES OF THE SKIN.

In this chapter we shall enter upon the consideration of treatment of certain diseases of the skin by electricity. I say of "certain diseases," although I am aware that dermatologists now class many disorders of this sort under the head of neuroses, and for these electricity is beyond all other remedies useful. So that while theoretically all skin diseases might be spoken of as within the rightful domain of the electro-therapeutist, it is not in the scope of these papers to touch upon any except those which practical experience has demonstrated may be cured or greatly benefited by electricity alone. It is quite natural *a priori* that this powerful agent should do great things in these disorders. When we consider its therapeutic effect upon deep-seated tissues and organs, and notice how irritation is allayed, how even local anæsthesia may be induced by the transmission of properly managed currents, it follows naturally, that in affections like those of the skin, where surface irritation is a leading symptom, electricity should be easily the first. And facts bear out the theory. Whoever will apply this wonderful agent to an eczematous limb, and mark how the itching and burning, which were a moment before so annoying, disappear as the circuit is closed and remain better after the treatment is over,

will gladly concede its value. All currents are useful, and I am in the habit of employing them indifferently, obtaining the best effects from galvanism in a majority of cases. Theoretically it should be the only form to be used, since we have seen in other diseases that its sedative influence is more marked upon nerves than faradic or static electricity, but practically it is not the best always. Why this is so is one of those many mysteries surrounding this singular form of force, of whose working we as yet know so little, and which seems as if it might end by revolutionizing the forces of the world. That there is a tendency upon the part of the profession in general to decry its effects in medicine I am well aware, and they find it difficult to understand the enthusiasm of the specialist, who obtains results which are due more to perfection of machines and expertness in handling them than to anything in the way of superior knowledge of electricity. Good tools, good work, is emphatically the law in electro-therapeutics.

Nothing is more necessary in treating diseases of the skin than absolute cleanliness of instruments and appliances. After using a sponge, or wash leather electrode, it must be carefully kept separate from the others, and destroyed at the conclusion of the course. Carbons may be stripped of their leathers and reburned, and in no instance should an electrode used in one case be employed upon another. All utensils must be scalded out and then disinfected with some germicide. Neglect of these precautions may be the source of unpleasant complications, and cases are not known where transfer of poison has thus been made. An ideal suite of rooms would have a chamber espe-

cially set apart for skin diseases, but that is still in the future outside of a few hospitals.

Diseases of the skin which have come under my care for electrical treatment are, acne, simple and indurated, eczema, psoriasis, prurigo, herpes præputialis, urticaria, moles, nævi and trichiasis. Others have had a wider experience, Beard and Rockwell citing cases of lichen, rosacea, etc., and Glax has cured œdema, with faradism. Outside of a hospital, however, it is improbable that the aid of electricity will be invoked except in a few cases of skin disease, and then only when the general practitioner in attendance has tried everything else he can think of, and failed. And in every case where it is to be employed, it cannot be too strongly insisted upon that the same general course as to diet and hygienic regulations be continued as if only drugs were to be called upon. Electricity is not omnipotent; it is simply one agent, and will not do everything, any more than opium or mercury. In combination with rational medicine, and in the hands of educated men, its range is undoubtedly wide and varied, and may in the future become far more so; but to attribute to it the powers of the entire pharmacopœia is the rhodomontade of the charlatan.

It is necessary in skin diseases to enforce the most rigid attention to diet, cleanliness and bowel regularity, before doing anything else. These preambles arranged we are ready to begin with our electrical work. The largest number of my cases have been acne, and of these, acne rosacea. It is surprising how many New England people have this disease. Perhaps generations of mince pie and fresh pork eating ances-

tors have a great part of this to answer for, but not all; for I have at present under my care a gentleman in whose face two years residence in our extraordinary climate has set its mark in unsightly knots of acne indurata. I am persuaded that in the majority of cases here, the climatic insanity to which we are constantly subjected is the chief thing to blame, and have in a slight degree demonstrated the correctness of my opinion by doing good work for patients who never exposed their faces uncovered to the outside winter air, and getting much less satisfactory results for those who persisted in neglecting such precautions in this disease. After having looked after the digestive, and in women the uterine functions, I begin electrical treatment as follows: With one pole of a faradic machine, no matter which, screwed down to its finest vibration and held in the hand, the other is pressed against a mould of the affected spot, usually the nose, made of a double fold of sheet lint, well moistened. This diffuses the current evenly, and avoids the disagreeable sensations which are sure to follow the application of a current of any high tension to so sensitive a surface as that of the face. Gradually increasing the force up to the verge of pain, continue for five or eight minutes, or until a sharp flow of tears marks what I term the saturation point. If possible these applications should be made twice daily for a week, and then daily for a month, after which I have found it better to stop for a couple of weeks. Indeed in all forms of electrical treatment where a prolonged course is imperative, it is better, as I have said in another chapter, to have resting spells of at least ten days, between each month or two

of work. Every other form of application has been tried, but none have proven so comfortable or more successful than this, and upon the painlessness of the operation depends its success. For it is utterly impossible to persuade a patient to come regularly when he is sure to be hurt every time, and hurt a good deal; and it is only by long, steady persistence that I have cured acne. There are only two points in the body more sensitive to faradic electricity than the nose—the lips and tip of the tongue—and that fact must be borne in mind. The indurated form is far more rebellious and difficult to cure, and it is scarcely worth while to begin a case without some sort of an assurance that treatment will be continued at least a year, steadily and faithfully. Not that such promises are of much use, however, for there are few persons who count them of any value in the face of such annoyance and trouble as attends a daily visit to a physician for a period of months, without probability of rapid improvement, and yet there is no other way to cure such an intractable disease. When electricity has been finally decided upon, it is applied as follows: Using the galvanic current from a battery of either high or low tension, in the former case from six fresh cells as a maximum, and with the positive sponge in the hand, press the negative pole, which should be a small round carbon button covered with wash leather and well moistened, upon the indurated spots seriatim. The current should be just strong enough to give a sharp burning sensation without really injuring the skin, and each contact should not be less than sixty seconds. Owing to the occasional abnormalities of effect when galvanism is transmitted through the

head, a watch must be kept for giddiness and faintness. Only yesterday a lady dropped in a faint in my rooms without the smallest warning, and the occurrence was by no means unique. When the button has been applied to a dozen indurations, it is better to stop than to risk any cerebral disturbance by continuance. While it is certain that these galvanic faints are unaccompanied by any permanent effect, so far as years of experience can say, there is no way within my knowledge whereby remote after effects upon the nervous system can absolutely be inhibited. We cannot yet tell what deep far away changes may be induced, or at least initiated by the passage through the delicate and complicated tissues of the brain, of a galvanic current sufficiently strong to momentarily suspend its functions of volition, and extreme care is necessary. Even then, these accidents are occasionally unavoidable and must be faced quietly, as the surgeon faces the risk of dangerous hemorrhage.

Case I.—Miss M. T., aged twenty, blonde, a beautiful girl and society leader in a distant city, came to me with a patient from Boston, a few months since, and after her friend's treatment was over asked me if I could not do something for her nose, which at intervals became vivid, a source of intense annoyance and no small mortification. It had a trick of getting red—a brick-red—upon exposure to either cold or warm currents of air. When she first came in, I noticed the tint, and thought it a case of acne rosacea, but paid no more attention to it. After her request, I examined it more carefully and was confirmed in my opinion. After two weeks preliminary regulation of diet and bowels, I began electrical treatment as

above described, and continued it twice daily for a month, the lady meantime boarding near by. She was then given a rest of two weeks, and daily applications resumed for two months more, when another rest was given, and another month terminated the case with what she considers a cure, and I trust will prove such. So far this winter (1886), she writes me, there has not been the slightest difficulty, although she has been frequently exposed to cold for hours at a time. It is, however, too soon to prophesy a permanency, and I record the case simply as an illustration.

Case II.—N. G., aged fifty, married, manufacturer. Mr. G. is a good liver, fond of a dinner and old wine. As one result of over-indulgence in these comforts he has for five years been the victim of slowly increasing acne indurata. The swellings were about the size of a bean, of a dark brick-red color and scattered thickly over the face—a little closer together on the nose than elsewhere. After obtaining from him a positive pledge to refrain from wine and high living for a year, a swear-off which was obtained only with great difficulty, treatment was commenced as above recommended, and steadily continued for a twelvemonth, with intervals for rest. The result, although by no means perfect, was a good one. The indurations disappeared and a great portion of the disfiguring color. He promptly returned to his old habits, which have not so far, after a year and a half, brought back the acne. There is plenty of time, however, and I am watching the case with great interest.

Eczema, in its most obstinate form, has been quite frequently treated, and the results average well, bet-

ter far than any I have been able to obtain by medicines alone. As the cases applying for special treatment are invariably hard ones that have been given up by general practitioners as incurable, electricity has been given an excellent test. If in the simple or primary stage the same opportunity were given and one-half the patience displayed as later on, I am convinced that much better results could be obtained. The plan of treatment pursued is a combination of central and surface galvanism. Supposing the affected part to be the leg, I immerse it in a suitable receptacle filled with warm salt water and connect the negative pole of a galvanic battery, either high or low tension, with the fluid. The positive pole is held in the hand. A current of from ten to twenty-four cells of the Flemming portable galvanic battery is permitted to flow as long as thirty or forty minutes, the guide being the sensations of the patient. If pain or fatigue make their appearance, stop at once. In case the eruption is in patches, the best way is to fold a soft towel four or five thicknesses, dip it in salt water and mould it to the part, then place between folds the negative pole attached to a flat piece of metal—a copper or brass disc a couple of inches across does very well—and proceed as before. Three applications a week are sufficient, and except in exceedingly bad cases two months is long enough time to accomplish a cure.

Case I.—Mr. M. G., aged seventy, retired manufacturer, consulted me February 21st, 1883, suffering extremely from eczema rubrum of the right hand and forearm. It had gone on almost to impetiginodes, with considerable constitutional disturbance and great

heat, But little relief had been obtained from any medication, and sleep was usually bought with an opiate. Central and surface galvanism were commenced, and the first application was especially comforting. I allowed the current to run nearly an hour into the tub in which the arm was immersed in warm water, and the pain was quite relieved, while the dusky red color of the skin was changed to a vivid crimson. After a month's treatment Mr. G. left town for Europe, and I have since heard that, while the disease was not cured, the amount of relief procured by galvanism greatly exceeded that following any other form of treatment. And perhaps this is all that can be hoped for in so obstinate a disease, or if temporary relief from pain and general disturbance can thus be procured, administration of arsenic, cod-liver oil, etc., may produce better results than when alone employed.

Three cases of psoriasis have been faithfully treated during the last four years, but the only result I can chronicle is a lessening of the annoying itching which usually accompanies this disease. Central and surface galvanism were employed as in eczema, with the addition of the faradic wire brush in one case, which so instantly increased the irritation and aggravated the itching that it was promptly abandoned. Prurigo has been treated in several instances for relief of the distressing itching and consequent sleeplessness, which is so constant and so annoying a symptom of this difficult disease. The galvanic bath, followed by central galvanism, was employed in every case. In using electrical baths it is a general idea that some costly form of tub and electrodes is a *sine qua non;*

and, indeed, my own belief was the same until I learned better. Some eight years ago I fitted up at very considerable expense an electrical bath-room and used it a great deal. But, after a distinct failure to get any better results than from the hand sponges, the baths were abandoned, and the tub torn down. Since then, when a bath is the better medium of electrical application, I carry a portable battery upstairs to the ordinary tub, hang one pole in the water at the foot, the other at the head and switch on the current. If I wish to localize either pole upon a particular spot, I simply lift it out of the water and apply there. Thus the whole matter of electric baths is simplified, and may be used by any one without any extra expense. The various combinations of cabinet, metal stools, silver-plated knobs and automatic bells, which are shown to the profession by professional drummers, are in my opinion worse than useless, for they would need an electrical engineer to keep them in order. An ordinary bath-tub and portable battery are all-sufficient.

Pardon this digression. My cases of prurigo got on splendidly for a week, slept well, the itching grew less and I hoped for a cure. But the current soon lost its soothing power, and nervous insomnia resisted it as successfully as it had done opium, belladonna, and Indian hemp. Still, I consider it well worth the trial and strongly recommend it.

Herpes præputialis has been treated in the same way, *i. e.*, by baths, which were of course local. Considerable difficulty existed in making the differential diagnosis between this and syphilis in one case, but it was finally decided that it made no especial dif-

ference as to treatment, and the result was a cure which settled the matter. The penis was immersed in a bowl of salt water, containing the negative pole, the positive being applied to the nape of the neck. Applications were made daily, and, after twenty, the patient was discharged, cured. Herpes circinatus has already been noticed under the head of neuralgias, where it properly belongs, and where its electrical treatment has been given in detail.

Urticaria, nettle-rash, if present in the acute form and localized, is peculiarly susceptible to central galvanism. If widespread, surface galvanism, applied with a large sponge, should be added to the central application and a single dose will sometimes cure, especially if the disease be induced by fright, overfatigue or the ingestion of some particular article of food. Choosing the latter form of treatment, the patient should be so stripped as to expose the whole affected surface, feet immersed in a foot-tub of warm salt water containing the positive pole of a low tension battery, and the rash quietly and slowly sponged for twenty minutes. After the skin is dry, wheals will be found absent, and a dusting with toilette powder closes treatment. Flannel underclothing can rarely be borne, on account of the intense itching it produces.

Case I.—J. F., aged thirty, powerful athlete, came into my office in the summer of 1880, badly scared, saying that he was covered with some sort of eruption. While he was undressing, he told me that he had been down the bay to a clam-bake and as the bivalves were unusually luscious he had eaten large quantities of them and little beside. The day was

excessively hot and he had been exposed to the sun for some time after the meal. Coming home, he began to feel faint and his wife noticed his face beginning to assume a strange color. My rooms happening to be nearer than any other physician's he came in, by that time covered to the waist with the long white wheals of urticaria, and believing that he had been poisoned. Galvanism was applied as above described, central first, then general, and in twenty minutes the whole thing had disappeared. A dose or two of bismuth and a caution about clams in excess completed the treatment.

Moles or nævi pilosi are amongst the most annoying of all the skin excrescences that disfigure the fair skin of a beautiful woman, and occasionally require attention in the case of a male exquisite. Some short time since, a plan was devised by me for removal of superfluous hairs by electrolysis, and I shall refer to the little operation later, but while under the head of diseases of the skin it is as well to mention moles and their electrical treatment. It is a simple matter to introduce a needle beneath the dark papilla, and, cutting off its vascular supply by coagulum, invoke its speedy destruction; but the succeeding scar is rarely much less apparent than original deformity, and in some instances its livid color is even more so. Only that the process involves some patience and a little pain, there would probably soon be none of these unsightly little nuisances left, and in spite thereof, the number of persons applying for their removal is increasing. I am in the habit of using the following method. With the positive electrode of a galvanic battery, high tension is the best, held in the hand,

the negative button is pressed firmly against the mole until the pain becomes excessive, as much so as a sharp toothache, for which purpose twelve cells will be sufficient under ordinary circumstances. More power can be used upon the trunk or limbs than any other part, but moles are rarely meddled with, except upon the face, neck, or arms, and the usual precautions against cerebral complications must be observed. When pain has subsided apply the button a second time up to the same point, avoiding blistering. Six or eight applications are usually sufficient to destroy the largest mole, which shrivels up and disappears without any scar whatever.

Trichiasis will be alluded to under the head of electrolysis, as will also be keloid, a number of cases of each having lately been treated.

In taking my leave of the present subject, I wish to recall attention to a statement made some way back relative to the extreme difficulty of healing galvanic burns. In the healthiest skin they cicatrize very slowly indeed, three or four months having been occupied in closing one, and where there is torpidity of capillary circulation they frequently remain permanently open. It is therefore much better to avoid skin lesion, and this can always be done by care. It will not do to depend upon the sensations of the patient; they do not tell what is going on under the firmly pressed electrode, and some of the worst blisters I have ever produced have been made while the patient was asleep, and the current was so slight that nothing of the kind was suspected. Remember that while no two persons possess skin of exactly the same fineness, all are equally susceptible

to galvanic burns, and all are sure to complain of them afterwards with remarkable unanimity. A close watch kept under the carbons and moving them as soon as the skin beneath is thoroughly reddened will be sufficient protection.

The next chapter will open with the consideration of electro-therapy in hysteria.

CHAPTER XIV.

HYSTERIA AND ITS ALLIES.

THERE is no disease, if hysteria pure and simple ever exists as a separate disease, which is at once so rebellious to medical treatment or so unsatisfactory in results as this. It is probable that more patent medicines have been invented for allied affections of this class, and more charlatans grown wealthy from "hystericky" patients than from any others. Nor have the regular profession been entirely left out in receipts from this source. While it is, perhaps, rare that electricity should be asked for in or near the explosions of this disease, there is usually accompanying the tendency a high-strung, nervous condition, the direct result of exhaustion, for which general faradization is one of the very best remedies. By exhaustion I wish to imply only that of nerves, as a large number of my hysteria patients have been stout women whose excellent nutrition and ruddy cheeks would seem to forbid disease of all kinds. It is no longer true, if indeed it ever was, that debility of general tone and weakness of nerve-supply are necessarily concomitant; on the contrary, I am of the opinion that lack of the latter is often dependent upon excess of the former, if such a paradox be admissible, and, at any rate, do not expect to see in a thin, anæmic patient any such hysterical symptoms as in one of the reverse

type. Accompanying this plethoric condition I am accustomed to find neurasthenia in nearly every case.

Morbid fears of person or of place, the thousand-and-one vagaries of an exhausted nervous system, predispose in the strongest manner to such convulsive attacks as are ranked under the disease we now have under consideration, and really are the only conditions admitting of detailed treatment. For, when a hysterical convulsion is over, there is nothing to do but to strive to prevent another—and it should be carefully borne in mind that this is no simulated suffering, that the disease is as real to the patient as if it were a deep-seated organic change in place of functional disturbance. In my list of cases of hysteria there is a large majority in favor of women, of whom the greater part, again, are young, and electricity has been employed both as a prophylactic and remedy. There is a certain number of cases wherein a sharp application of spinal faradization will promptly abort the attack—but these are difficult to reach by reason of want of notice. When a chronic case of hysteria comes under my charge I am in the habit of leaving a faradic machine in the house, and directing a strong current to be applied to the spine, one electrode at the base, and the other at the nape of the neck, for ten minutes. In almost every instance the attack may be averted. But when it is deemed best to enter regularly upon electrical treatment of a chronic case, in the hope of cure, it is better to combine galvanism and faradism; the former central and the latter general, and to make two applications daily, the former in the morning and the latter toward bedtime, as the strong vitalizing effect of the induced current is more lasting at night.

Great patience and perseverance are necessary, making at the same time such changes of diet, exercise, and clothing as seem necessary. Now, I suspect that no amount of electricity would avail without sound physiological adjuncts, and am accustomed to reckon the strong and subtle influence of change of place as easily the first. It needs not a long and expensive voyage to foreign lands; eyes that have always rested upon the low hills of our sea-coast know mountains only by pictures, and from ten miles distance a hill of a thousand feet is to them the majestic Jungfrau, about whose top imagination quickly wreaths a sparkling crest of everlasting snow. There is something in this change—some magic that wiles the slinking devil of nerves from his hole and crushes him beneath its novelty—something more potent than drugs—more reviving than bodily exercise—more tonic even than the silent force of electrical flow—to which we may address ourselves confidently after apparent hope is gone in these curious cases of hysteria; only it wears out. Bereft of newness it soon becomes a bore, and the delightful preparations, so full of anticipation, are changed to weary work without savor or faith. Use it then with great caution.

That form of paralysis dependent upon hysteria is by no means uncommon, and in the uncontrollable muscular contractions produced by electricity I have found almost as sure a cure as the Grotto of Lourdes. It is only essential to persuade the patient that some agency far more powerful than her own is at work, and it is but a question of time before she will submit. In most of these old cases there is a confederate who keeps up the illusion for some reason of gain or

fame, and renders it more difficult to have one's way, so far as inflicting actual pain goes. In these cases all display possible should be made of instruments and appliances, and as much curiosity excited as may be. Supposing the useless member to be a leg, and, no matter how long the alleged time of confinement, it will be found round, plump, and muscular—place a flat sponge-pad under the sacrum, and using that for a central electrode, connect both poles with a powerful faradic machine and begin. Current direction is of no value whatever. Press the carbon tip in your hand upon the nutrient nerves of muscles in turn, beginning with the rectus and working around, bringing them up with a sharp jerk and considerable pain. It is not only the muscle-fibre that must be treated, it is the will; and if the machine does not conquer at once, it is as useless as the many other failures that have preceded it. If, when the treatment is finished, the patient is tired, exhausted, a little frightened, and very much impressed, the work has been well done, and one of the "greatest cures of the year" may fairly be anticipated. Now push the attack. Go daily or, if you have time, twice, even thrice daily, and so besiege the patient that she will help to get well in very self-defence.

Among the more uncomfortable minor hysterical disturbances is that twitching of the palpebral or orbicularis muscle that comes with general muscle-tire, and is very intractable. I have found that it sometimes yields to a few applications of the constant current, made as follows: Holding the positive electrode in the hand of the affected side, press a small sponge connected with the negative upon the irritable muscle,

and pass the current steadily for a few minutes. Two or three applications in this way will usually relieve the annoying condition otherwise very persistent.

CASE I.—Mrs. E. B., widow, aged thirty-five, robust blonde, teacher. For several years past Mrs. B. has been subject to attacks of hysterical excitement, which would occasionally get the best of her, and a series of explosions of laughter and tears would follow. Ordinarily her exceptionally strong will keeps overt attacks under, but the result of the fight is worse than that of an attack. Functions regularly performed. It is a curious study in this case to watch the contest continually going on between the powerful muscular development of the lady and her slender store of nerve force. Beneath the skin is a constant quiver of fibres agitated like the ripples of a pond under a summer breeze; her voice is soft and quavering, and her eyes are filled with unshed tears. All these are held in check by a dominant will, and the contest seems eternal. In such a case, which is by no means an uncommon one in the highest ranks of American society, help is eagerly sought—first from physicians, and failing there from any source whatever. And for such a case I believe electricity is the surest aid. Mrs. B. has general faradization and central galvanization applied alternate days for two weeks at a time, which is sufficient to reinforce her nerve-centres for the time being, and she goes on again for an average period of six months, when help is again sought. Under the high-pressure life she leads I doubt if any better result can be attained.

CASE II.—Isabel C., aged twenty-six, native of Rhode Island, medium brunette. Family highly

scrofulous ; one sister died at thirty-two of an immense uterine fibroid, another of consumption, and a third is often under treatment for scrofulous ulcers. Transferred to me by the late Dr. Thomas W. Perry. During the school-days of Miss C. she was in the habit in common with many young American women of paying slight attention to regularity of functions or of food, and pushed her studies with the utmost vigor. Before graduating was obliged to stop school, by reason of mild attacks of hysteria, which produced considerable mental confusion. Other previous history of the case unknown. When I assumed charge, she was confined to her bed, and had been for nine years, with contractile hysterical paralysis of both legs, double paraplegia, and absolute paralysis of all neck muscles. Her head was as completely out of her control as if it were that of an infant a week old, rolling and falling about in quite as helpless a way. Taking her out of bed with the aid of my assistant, her legs bent under her without the smallest support. She complained of severe pains in back and hips, passed large quantities of limpid urine, and presented no other abnormal appearance. Her legs were of natural size and quality of muscle.

Treatment was commenced by faradization of neck muscles, which soon began to respond to the stimulus, to regain contractility, and in three months control over head movements was complete. But no amount of treatment, electrical or otherwise, had the smallest effect upon the paraplegia, until it was suggested that a gentleman friend, who had remained faithful all these years, ten having now passed since she confessed to being upon her feet, would probably

decline to join his fortunes to a hopelessly bedridden woman. From the day when she comprehended this, recovery began, and went on for a time with rapidity. She grew able to go about the room on two crutches —then on one—then with a cane only, and inside a year came to my rooms, a distance of over a mile, in a street car, leaning upon her sister's arm. She then began some light home labor, and earned some money for a time. But, sad to say, the gentleman to whom she was attached announced his decision to marry another woman, and with this untoward news Miss C. began to decline. Her limbs began to lose tone and strength, and, although she has not again been confined absolutely to bed, the temptation to be so is evidently strong. She comes to me now and then, but what is needed more than electricity is evidently another marriageable gentleman. After a few days spent at Lourdes two years ago, where every facility for investigation was afforded that was compatible with rules, I am satisfied that the cures there accomplished belong entirely to the class of Miss C. It may be added that Dr. Perry, at a meeting of the Rhode Island Medical Society, characterized the restoration of the function of the neck muscles in this case as "truly wonderful." That was in 1874, before such results were as common as they are now.

Hay-fever has been successfully treated by central galvanism. Several years before his death, my lamented friend, Dr. Beard, and I tested this subject pretty thoroughly. He was convinced that the disease was a pure neurosis and should be controlled best by electricity in some form. In every American city there are cases of this uncomfortable disorder,

for which life in the White Mountains or other anti-hay-fever locality is out of the question by reason of lack of funds, and a few of these were hunted up and persuaded to try electricity, the same to be without cost. In all, eleven cases were tried, and with excellent preventive effect in three, marked modifying effect in six, and none at all in two. The applications were made morning and evening, with downward current and twenty minutes duration. It is my conviction that a majority of cases of hay-fever, where the period of onset is as easily calculable as a solar eclipse and as sure to come, may be aborted by a week's previous central galvanism. The most striking of the three cases successfully treated was published by me at the time in the Boston *Medical and Surgical Journal*, under the title, "A Case of Hay-Fever Successfully Treated by Galvanism," of which I will endeavor to recall the main points.

Case I.—Miss E. W., aged thirty-seven, native of Rhode Island, brunette, a lady of wealth and excellent family, had hay-fever each year, the attacks supervening with marked regularity at noon of a certain day of the month. If she went away the day before to Bethlehem or any other locality in the White Mountains, she would miss the onset and be free that year, although she returned to Providence the next week. Circumstances rendered it impossible that she should make her annual hegira the year in question, and, as her niece was at that time under my care, and we had had several talks about galvanism as an abortive of her disease, she consented to try it. Using a low tension galvanic battery, I commenced galvanization of the sympathetics and cord

twice daily, twenty minutes at each sitting. As the day drew near—we had begun a week before—I gave a midday treatment also, and in brief, for the first time in many years, her ordinary supply of handkerchiefs proved sufficient. She remained all summer at home, but I cannot remember if the disease appeared or not. The next year and since, she found her mountain summer home more attractive than the galvanic battery, and as it is at least equally efficacious has availed herself of it.

Rheumatism in its various forms has been one of the strongest vantage grounds of electro-charlatans ever since the regular medical profession found the mysterious force too troublesome and too uneven to repay their careful attention and study. Such wonderful results have occasionally been reached by men who have never studied medicine a day, that the temptation to lump them all in as falsehood is almost irresistible. But truth is now and then mighty, and men who have really recovered lost motility in rheumatic muscles, or gained freedom from pain in tender tumefied joints by use of electricity, will not submit to be called liars because their so-called doctor never studied medicine. He cured them, and that after all the others failed, which is sufficient. And really in this part of the nineteenth century, the public, our patients, demand simply cure. Better that from a charlatan than the most accurate and beautiful pathological specimen ever set up by any college professor living. So, if certain forms of rheumatism are better treated by electricity than by drugs, and of this there can no longer be any doubt, it seems but fair argument that the profession should avail themselves of

this powerful agent, in such form and way as the widest possible experience approves. To this end we write. In classifying the long list of cases of rheumatism which have applied to me for electrical treatment, the greater number are registered under the head of subacute. Muscular and chronic come next, and there are but eight acute cases in twelve years, of which the greater part were rheumatism of the hand, fingers or scalp. In considering the disease, it will perhaps be best to preserve the same arrangement.

Subacute rheumatism comes most frequently to the specialist in the condition following and dependent upon the acute form. Pains are no longer shifting nor acutely severe; they are well localized and of a dull aching character, unaccompanied with high fever or much constitutional disturbance. A sense of general stiffness in the muscles and joints of a limb or section of the trunk is the chief cause of complaint, and it is uncommon to find changes of weather make any material difference therein. Let the case be of the most common type, that of the trunk, and electrical treatment is pursued as follows: With the patient stripped of clothing and covered with a loose woollen wrap, the temperature of the room not being less than 80° F., seat him upon an electric stool, *i. e.*, one having a covered plate of copper let into the seat, connected with the cords from below. This should be attached to either pole of a powerful faradic machine—the full strength of Flemming's No. 1 is always enough—and the other to a sponge-pad to be held in the hand. With the other hand dry, and the patient's skin dusted with starch powder, commence with

indirect faradization. Make long strokes down the trunk from shoulders to stool, using as strong a current as the operator can bear—the patient will scarcely notice it. Continue at least twenty-five minutes; half an hour would be better, and repeat once daily. I have found that it is better in these cases to have a morning than an evening hour—the case gets on better—from some unknown reason. From a like hidden cause indirect applications have proven better than direct, and the treatment is always tedious. It is better to say months than weeks when answering questions as to its probable duration. But, if it is long, it is wonderfully effective, and there are cures upon record which have resisted every other treatment, hot springs included.

Muscular rheumatism is a much easier disease to handle. Originating either from a stroke of cold or a strain, it is localized, acute, and ordinarily transient. Its most frequent locality, next to the lumbar muscles, has been in my experience the shoulder, including the lower neck, pectoral and scapular muscles. Both galvanism and faradism may be used with advantage in these cases, as follows: Strip the affected side, observing the same precautions as to temperature. Let the patient hold the positive pole of a galvanic battery—no matter of what tension—in the hand of that side, and with a sponge electrode attached to the negative, go over the painful surface until the skin is well reddened. Then transfer the wires to a faradic machine and cause each affected muscle to contract firmly in turn, stopping just short of extreme pain. When the sitting is done, if it has been well done, there will be no pain or soreness left. This

happy condition does not usually persist, however, and ten days are needed, as a rule, for the cure of ordinary cases. In some instances, particularly those arising from overstrain, a longer time is needed.

In acute cases the galvanic current alone should be employed, and great care taken to avoid current changes or breaks which would cause contraction shocks and consequent increase of inflammatory action. Taking the knee as a location, treatment is best conducted as follows: Observing the same temperature precautions as before, envelop the knee in a jacket of absorbent cotton or sheet lint, well moistened with warm salt water, carefully protecting the clothing from wet with sheet rubber or oiled silk. Over the lint wrap a square of tin-foil soldered to a flexible wire which is attached to the positive pole of a galvanic battery—the portable mentioned in the first of these papers is the best; and the negative, connected with a flat sponge-pad, is placed at an indifferent point. Switch slowly into circuit as many cells as can comfortably be borne, taking care to change the negative pole every few minutes to avoid cauterization of the skin. The current should be continued steadily for twenty minutes at farthest, when a marked decrease in pain and nervous excitement is usually perceptible. Slowly switch off the circuit and the sitting is done. This should be repeated daily, and used in connection with constitutional treatment, which it aids and hastens to a marked degree.

CHAPTER XIV.

ILLUSTRATIVE CASES OF ACUTE RHEUMATISM.

THEODORE A., aged forty-six, market man, rugged and robust, with excellent family history, exposed to all weathers in his business, contracted rheumatism December, 1885. A typical case. When seen had acute pain from shoulder to wrist of right arm, with glossy swelling and high fever. Also anæsthetic patches in course of ulnar nerve distribution, and occasional nervous discharges in tips of fingers like touching hot iron. Constitutional treatment excellent under care of family physician, and electricity was called in as a relief to pain at patient's request.

Galvanism alone was employed, with descending current from twelve Grenet cells, portable battery, the hand wrapped in towels wet with warm salt water, and sitting lasted twenty minutes. Great relief was experienced from pain, and at the next visit much of the swelling had also disappeared. Two more sittings were all that were needed to banish pain and soreness from the arm, and I afterwards learned that the case progressed favorably to cure.

Subacute.—Mary S., aged thirty-two, robust Scotch woman, single, worker in cotton-mill. Has had occasional attacks of rheumatic pain for several years past, which have given way before simple remedies

without much trouble. Six weeks ago she was attacked with dull, heavy ache in flexor muscles of right thigh, accompanied by stiffness of limb, which kept its grip without regard to the various liniments, etc., that were liberally applied. Locomotion grew difficult and painful and two weeks ago she came to my rooms for treatment. Disease quite localized in muscles of right thigh and hip, including structures about hip-joint; no general disturbance. Four sittings, using indirect faradization, sufficed to relieve the patient completely. The plan pursued was that described in the last chapter.

Muscular.—George A. S., manufacturer, aged sixty. Has frequent attacks of rheumatism in neck muscles, so sudden as to give no warning before his neck is fixed, lasting for twenty to thirty hours, with slowly decreasing stiffness, but continuing pain. Thinks cause is exposure in the trenches before Vicksburg. In this case I found after repeated trial that galvano-puncture was the most effective form of current, applied with an electrode of five needles which slightly transfixed the skin, connected with the negative pole of a six-cell Daniel series, the positive connected with a large sponge and made mobile. Five minutes current of this description was sufficient to allay pain and motility was then restored by massage. There is probably no cure for this case, as the patient will not take care of himself during intervals.

Exophthalmic goitre or Basedow's disease, as it has been occasionally called, is an infrequent visitor to my list; but as several cases have been cured by galvanism, and two at present under treatment are improving steadily without other remedies, I place my

technique upon record here. Essentially a disease of the sympathetic and probably of its cervical portion, our whole reliance must be upon galvanism applied in that locality. Whenever the mistake has been made of using faradism in goitre, serious loss and injury have been suffered. Loss of precious time, since after the disease is sufficiently progressed for a specialist to be called in, cardiac weakness and turbulence are so far advanced that death from heart failure is imminent, and any such additional impetus to its labored action as faradism is but fuel to fierce flame. Whoever has listened to the rapid, weary, feeble, and irregular action of a heart in one of these cases will at once see the prime need of a sedative—a calmative, so to speak, to its irritated nerves. And directly opposite in effect is the induced current, which should never be employed in this disease, not even as an application to parts distant from centres.

Galvanic treatment, to be effectual, must be steady and long, and it is always best to inform a patient that only slight improvement may be expected until after a year at least, while much more time may be needed to effect a cure. But this long period should not be made irksome, as applications need not be made more frequently than twice weekly after the first month or two, and an intelligent relative can easily follow them up at home, care being taken to keep the case under close surveillance from beginning to end. Neglect of this precaution occasionally leads to an unexpected death in one's practice from sudden heart failure.

Galvanic applications should be made with regularity every day for three months as follows: Using

a constant current of three milliamperes, six fresh Grenet, or ten Leclanche cells, place the negative electrode, a skin-covered carbon, over the solar plexus, and the positive, a narrow bar, in the sterno-mastoid fossa, over the superior cervical sympathetic ganglion. With a good rheostat in circuit, bring electromotive force up from zero to the strength above indicated, with great caution, and allow three minutes to each side, always decreasing force to zero again before removing neck electrode. Substituting for this a sponge electrode three inches in diameter, well wetted, placed upon the vertex, slowly turn on the current again until patient distinctly feels or tastes it, continue five minutes longer, and the sitting is over. I never touch the goitre or eyes at all until cardiac turbulence is calmed, and improvement in general symptoms manifested by returning strength, gain in flesh, lessening dyspepsia, and better sleep. Then applications are made direct to the enlargement, and I have found McIntosh's neck electrode the very best thing to work with in this locality.

Of course, any intercurrent symptoms must be met, but it is rare that drugs can be used with any benefit, although an occasional dose of bromide may aid sleep. Great caution in increasing electro-motive force through sympathetic ganglia is advised, because any sudden galvanic impression upon these centres is promptly followed by giddiness from quick contraction of cerebral arteries and increased heart disturbance from overstimulus to cardiac nerves. It may happen that three cells, one milliampere, will be all that can be borne at first, and too much care cannot be taken.

Towards the end of treatment, when only eye pro-

trusion is a noticeable mark, more time should be expended upon cerebral currents, and direct work to the goitre may be abandoned as soon as marked decrease in its size has occurred. A favorable prognosis may be given when general strength is still sufficient to embark upon the treatment, and when dyspepsia has not become a prime factor.

CASE.—C. W., aged thirty-three, unmarried, brunette. Father died of heart disease. Up to the age of thirty was in excellent health, when she began to have severe attacks of heart palpitation, coming on weekly, slowly increasing in frequency. In May began to notice a growth, a roundish tumor in the neck, which had been for some weeks preceded by protrusion of the eye, with peculiar glazed appearance of skin of face. She had severe headaches for two months or more, extending over the entire head, with most pain over eyes. No tinnitus or vertigo.

Condition at beginning of Treatment.—Well-marked thyroid enlargement to three times natural size, marked protuberance of eyes, great weakness, frequent nausea, bad sleep with nightmare, increasing emaciation and nervousness, with a heart's action that seemed tumultuous enough to tear open the frail chest in which it was confined. Pulsations beyond count.

As the lady was possessed of great intelligence and ample means, I explained to herself and family exactly what I believed would be needed in the way of time, and began with galvanism as above described.

For a year almost daily applications were made, and a single month had not passed before the turbulent heart began to quiet down. Improvement then

came in sleep, diminution of nausea, and gain in weight, decrease in size of gland not fairly beginning until after a year. It will be three years in October, 1887, since I commenced with Miss W., and she is still under care, with scarcely a trace of thyroid enlargement; pulse full and strong at 72; weight 140 pounds, and nearly normal strength. Eyes still remain somewhat protuberant, but are slowly subsiding.

As a case illustrating the effect of persistent galvanic treatment, no less than the patience of the lady, I do not recall its equal on record; and no longer hesitate to give a favorable prognosis in all cases where a similar regimen can be followed.

Anæsthesia of all portions of cutaneous surface that are subjected to an induced current for any length of time is a common result. Directly opposed to the action of galvanism, which is felt more and more strongly as the skin grows more fully charged with blood—becomes a better conductor—faradism diminishes sensation rapidly until an amount of electromotive force which would have been unbearable at first, is scarcely felt. I have taken advantage of this condition, which appears to come from suspension of reflex transmission by superior strength of electrical force, to remove warts, moles, etc., about hands, arms, and shoulders of patients who would otherwise have demanded ether.

Cataphoresis, or treatment of deep-seated neuralgias, by diffusion of chloroform through the tissues, has lately been devised by Adamkiewicz, of Cracow, and has proven worth a fair test by results of two cases in my hands. The professor has devised what

he calls a "diffusion electrode," which I have replaced with a simpler arrangement, and find no difference in effectiveness. This process is to be used in cases of sciatic or other deep-seated neuralgias where galvanism alone seems insufficient, or where a rapid relief from pain is essential. I have failed to attain complete cures by a single trial, as the distinguished Pole is reported to have done,[1] but believe that it comes within the limits of this work as an entirely practical use of galvanism. In default of the author's "diffusion electrode," I have twenty minim doses of chloroform put into pearls that are easily broken on pressure, and use them thus: Place a single pearl in the centre of a sponge-covered carbon electrode connected with the negative pole of a galvanic series of twenty cells. With positive electrode held in patient's hand, press the other firmly upon the skin over the affected nerve-trunk, and tap its handle sharply enough to break the pearl; bring at once into circuit all electro-motive force possible up to a point short of burning and hold it steady five or six minutes, during which time galvano-absorption is complete—the chloroform has been driven into subcutaneous tissues or through them; for prompt cessation of pain evidences its arrival at its destination and a successful result to the little operation. Perhaps a lack of perfect instruments has prevented me from having such good fortune as Prof. Adamkiewicz, for there is usually need of several repetitions of dose to complete cures that he has attained in a single one. But it is well worth trial.

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[1] *New York Medical Record*, p. 552.

Since writing the foregoing, I have received from Flemming, of Philadelphia, one of the diffusion electrodes, made by him after original drawings, and am glad to say that it is in every way an accurate copy, and can be furnished cheaper than it is possible to import it.

CHAPTER XV.

PARALYSIS.

PARALYSIS, that suspension of sensory or motor functions, or both, more or less complete, dependent upon central disease only or upon peripheral causes, has been a battle-ground whereon electric force has been fully employed ever since its discovery, and where it has won many a victory over drugs and other methods of cure. For many years after its adoption by charlatans, before science in medicine had found time to turn its investigating rays upon dense clouds of ignorant superstition that hid the gem beneath from her disciples' eyes, and bring to the front a chief ornament to her crown, paralytics went in crowds to Paris and to Bologna to be cured by what priests called "the new demonology." It would appear that sufferers in middle ages had some of the same erratic tendencies that are to-day occasionally displayed; they insisted, now and then, upon getting well in their own way, in spite of regular medical attention. So charlatans flourished, lame and halt were made to walk, and the profession passed by on the other side. But we have changed all that. The demon that resides in the box is now known to be a beneficient gnome, whose powers are ever at the service of human kind, and are nowhere better displayed than when countermining some of the ravages that paralysis makes in the human frame.

There are few conditions so much feared as utter helplessness. To be dependent upon another for every little service essential to life or comfort; to feel useless the good right hand dangling limp at one's side and looking so well and strong; to miss sensation and motion in the legs that were ever so ready to run one's errands, and watch them as if they were parts of some other frame, subject to some foreign will; to feel conception of brilliant ideas, of recondite thought proceeding as of yore in the intellectual brain, and yet know that the machinery that would so gladly give it to a waiting world is clogged, perhaps forever stopped; to be an object of pity where one was always envied and admired; to hear even friends say: "Ah! poor fellow, he *was* such a noble man! How awful it must be for his family to be so tied down to one already dead as far as recovery goes;" to watch days go past and lonely nights come on with senses made preternaturally acute and sensitive by failure of power to express their wants; to suffer agonizing pain that recalls stories of inquisition torments and be denied relief by complaint or demand for sympathy—this is that death in life which most men fear far more than they do any darkness of Styx, any quick summons from the angel of the hereafter. From such combined mental and bodily torments they have always sought relief; if not in cure, then in the welcome silence of the grave.

And to play an important, nay, in a certain class of these cases, the only possible part, electricity comes in. What the next generation, with increased facilities for study, may find possible by its powerful aid,

I cannot even conjecture, but it would be unwise, considering the immediate past, to deny it any possibility or even seeming impossibility.

But just now electricity can do much in certain forms of paralysis; can cure certain others.

As a general rule, it is better to avoid its use in very recent cases, where a central lesion is believed to be the origin. Complete quiet, absolute rest of body, and semi-torpor of mind, which are among the essentials for a few days after supervention of paralysis, are not consonant with exhibition of any force whatever. Even slight disturbance has precipitated a new hemorrhage from an open artery; it is better, then, to wait long enough for any such injury to be healed. As a rule, electricity should not be employed in a case of paralysis from central cause until after the fifth week, and then with utmost caution when the head is approached. It will be safer to depend upon reflex influence from surface applications even then for a few times, until it is decided that stimulus is well borne. All treatment should be absolutely painless. It is quite possible to arouse sudden cardiac action by what would be an insignificant hurt in health, but a sharp shock to an enfeebled nervous system, and no good ever results from such procedure. Insomnia is a frequent accompaniment of paralytic states, and is most successfully treated by descending galvanism from the top of the head to the solar plexus, and galvanism is also the best form of electricity to use in any neuralgia that may become troublesome in great nerve trunks.

For motor paralysis only faradism is of value, and should be employed in a general way at first, only

coming to direct applications later, and all treatment is usually prolonged.

Paralysis agitans (shaking palsy) has been successfully treated by me in a single instance only; but that solitary cure, together with marked amelioration in several other cases, warrants me in advising galvanism in every case. Both Remak and Gull have reported cures which were, I presume, of the same class as mine—functional. In the senile form, however, where drugs fail, and tremor of a limb is accompanied by disturbances of equilibrium and by decay of advanced years, there is nothing to be expected from electricity except an improvement in general tone and some suspension of involuntary movements during sleep. This improvement is occasionally very marked, and the resultant increased strength is sufficient to mask tremor very considerably, and make life tolerable again. A galvanic current of ten Leclanche cells or three to four milliamperes is sufficient, and should be used as central, sympathetic, and direct to a shaking hand. The negative pole should be always uppermost, and care taken not to increase tremor by too long applications, which are fatiguing. Ten-minute doses have proven quite sufficient, and should be repeated daily for at least three months at a time.

Dr. C. W. P., aged sixty-five, native of Rhode Island, consulted me in May, 1886, for paralysis agitans senilis of the right hand and forearm. There were no signs of complication, no serious anomalies of walk or speech, and the case was at once put under galvanic treatment. Although the doctor's attendance was far from regular, less than a month was enough

to develop some improvement, and in two he was better. Only galvanism was used as above indicated. I heard from him but a short time since, and am glad to report that his gain appears to be permanent.

Bulbar paralysis, so long and well known under the name of glosso-labio-laryngeal, that progressive form of motor loss in muscles supplied from the medulla, owing its existence to atrophic degeneration of motor nuclei in the bulb, is still apparently incurable. It is so rare a form of disease, however, that no sufficient trial has been given to electricity in its treatment, at least in my hands, or in any records to which I have had access. From the nature of things, I would be disposed to view hopefully any case where an early diagnosis was made and galvanism given full swing. Certainly, no other method of treatment has proven successful, and electricity could do no harm even if it failed with the rest. And it has the advantage of not interfering with any medication that may be deemed advisable by physician or necessary by patient.

I have had but three cases in five years, none of which were under my own care alone, and in two of which galvanism was not used until death was close at hand. Treatment in all was the same: descending spinal galvanism, with mild transverse currents across the medulla and direct faradism to affected face muscles, using finger-tips for electrodes, as increased sensitiveness to electriity was a symptom in each instance.

Mrs. C., aged fifty-four, native of Rhode Island. Was attacked with primary symptoms of bulbar paralysis about two years before I saw her in consultation

with Dr. Millar, of Providence, who promptly recognized the disease, and placed her upon usual treatment. Later, galvanism was employed. When I saw her she was already practically confined at home by reason of deficient articulation, difficult mastication of food and swallowing, and inability to retain same within buccal cavities while eating. Galvanism was at once commenced as above suggested, and for some months decided benefit was obtained. During the latter part of treatment the lady was supplied with a Flemming constant battery, and all applications were made by a relative. But improvement was but temporary, and Mrs. C. died of slow starvation. In this case, where gain was for a time well marked, the result would seem to indicate an earlier and more persistent employment of electricity. Indeed, it cannot at present be expected to do more than delay death, unless employed at the instant of recognition of this special central lesion.

Far better success has attended electrical treatment in infantile paralysis, acute polio-myelitis. Even when far advanced, when growth of one group of the child's muscles has progressed beyond the other far enough to produce some form of clubfoot, cure is possible. Sudden in onset and frightful in aspect to the baby's friends, a favorable prognosis may be given as long as electro-contractility in paralyzed muscles is not entirely destroyed, but cure must be long postponed. If the observations of Charcot, Prevost, and others be true, that the process is usually inflammatory, commencing in the nerve cells, affecting afterwards the neuroglia, later the motor nerves and muscles with atrophic degeneration, there would

scarcely seem to be much ground for hope. But my great number of successful cases, and those recorded by other observers, incline me to believe either that those gentlemen are mistaken as to a majority of cases, or that electricity, properly and persistently employed, has power to arrest advanced degenerative processes and restore by reproduction cells, that have been destroyed. In making an electro-diagnosis of this disease, it should be remembered that electric response is exalted, as in all cases of spinal nerve irritation; but while this is invariably the case as regards sensation, motor reply comes slowly, often needing a high electro-motive force to evoke it. As paralysis is usually partial, and as useless muscles are rarely rigid, treatment should be composed of descending spinal galvanism of two to three milliamperes—four to eight Leclanche cells. As an infant cannot sit upon a flat sponge, it is convenient to give the mother charge of the negative pole, with instructions to hold it firmly against the coccyx, while the doctor presses the positive over the cerebro-spinal axis. Short sittings only are admissible, usually not exceeding five minutes. Then each paralyzed muscle should be taken in turn and direct faradization thoroughly done, using the finger-tips as one electrode—no matter which—the mother still continuing to hold the other. Do not expect too much at first. If a muscle fibre has answered during diagnostic examination others will follow in time, and it is essential "not to hurt the patient." Neither baby nor baby's mother will stand that for any length of treatment, and, in fact, it is necessary to be very careful with children in using faradic currents; they

are normally hypersensitive from rapid capillary circulation.

After a month, after baby's confidence is fully gained and his friendship won, and motion is still delayed, enough power should be used to firmly and quickly contract the worst muscle once. This may be done so deftly that before astonishment at the new sensation has had time to merge into pain the sitting is over, and enough is done. Wait until next day, and take two, slowly increasing until the desired end is gained. I am thus particular in describing technique in this small matter—small only, however, when the patient's size is meant—because several failures in the hands of excellent physicians have turned to successes in mine only, I am convinced, from more time and greater care having been taken.

Mamie L., aged twelve, native of Rhode Island; no family history. From the practice of Dr. Carver, of Providence.

Four or five years before had a slight fall, striking upon nates, to which no importance was attached at the time, although some soreness followed the injury. From that day, however, she has had continual backache, and has never been able to run about like other children. Has no control of legs, which are much smaller than usual at her age, soft and flabby. Electric tests give no faradic response with any possible current, but a well-marked contraction from fifteen Leclanche cells was obtained on reversing circuit direction. Treatment was pursued diligently until June, 1885, ten months in all, with a complete cure as result. At that date tendon reflexes, previously absent, were restored to knee and

ankle, each thigh measured forty-two centimetres midway; no spinal tenderness remained, and the child could walk as well as any one.

I saw the mother but a few weeks since, and learned that Mamie continued well.

Writer's cramp, that curious form of spasm whose etiology is so far purely supposititious, has been treated with considerable success by galvanism alone. That the lesion causing this lack of voluntary control is central, I have become satisfied from observing improvement in my cases only when cerebral applications were made, no relief whatever having been observed from diligent use of electricity in all forms applied directly to the affected arm alone. Just what that lesion is, or where it is, however, is still unknown; but it is important not to waste time upon experiments that have proven useless. Entire abstinence from whatever form of exercise is habitual to the sufferer as a means of livelihood, whether writing, piano playing, or painting, must be rigidly adhered to, and the patient's general health carefully looked after. It is usual to find a lack of nerve tone, a run-down condition, in company with writer's spasm, and proper tonics should accompany electrical dosage, which is confined to central galvanization alone. In every case under my care for ten years this has been alternated weekly with direct faradization and static sparks to affected muscles, and I am satisfied that all improvement made was under the constant current.

Applications should be made daily for a month, and then twice a week until the case is cured or gain ceases. Bearing in mind that cerebellar disease produces lack of coördinate muscle work I have di-

rected the last part of my sittings through that organ. But, although many cases have improved and a few have been cured by strictly following this course, as long as causation of writer's cramp is utterly unknown, any localization of treatment can only be empirical.

A. Y., aged fifty-eight, manager of cotton mills. During a long business life has been closely confined to business without much regard to hours, and no vacation, sitting steadily at his desk. About ten years ago, while writing a letter, found his pen suddenly arrested short, remaining immovable, or if not stationary it would start off at random in any direction. If an attempt was made to carry a parcel of a pound or two weight, a spastic rigidity of the arm came on and the hand could not be raised. These conditions, with loss of control and agitation of right forearm, gradually increased. During the past four years his responsibilities have doubled, and insomnia came on. Was obliged to leave business, and began use of narcotics. At date of consultation it was with utmost difficulty that Mr. Y. held a pen at all, and his penmanship, when after a long effort he succeeded in writing name, date, and address, consisted of a series of small irregular connected lines, half a dozen to a single letter, rather than one long, steady sweep; showing a nerve supply coming in a series of short jerks, rather than by even flow. Both dynamometer and æsthesiometer gave marked loss of power and sense of touch.

Treatment was commenced January 1st, 1887, and continued two months, with most gratifying results. His arm grew stronger and steadier, and penmanship

was very much improved. Finding himself so much a gainer he relinquished attendance, and now, June, 1887, is attending again to business with much comfort.

The forms of paralysis here described by no means comprise all for which electrical treatment is required and demanded. But they include most of those wherein special directions seem necessary, while to write of each rare specimen of motor or sensory impairment would be far beyond my scope.

CHAPTER XVI.

ELECTROLYSIS.

ELECTROLYSIS is the chemical dissolution of a substance that is capable of conducting electricity, into its component elements, by a high tension current and subsequent removal of *débris* by absorption. Both these steps form part of the surgical process under consideration, although the former only is included in an etymological definition of its name.

Differing from galvano-causty in that the latter is purely a mechanical process, it is nevertheless frequently confounded therewith, and the two spoken of indifferently, so that it is necessary to note characteristic distinctions. A high tension, or electrolytic current, is one which is produced by a number of cells connected in single pairs throughout; a quantity, or heating current, comes from a single one, or at most two connected as one.

It is a law of electricity that all current from a series, no matter of how many cells, is derived from the first; each succeeding one to the first acting merely as an intensifier or driver of the force already originated; and that, so far as this quality of tension is concerned, the size of cell makes no difference whatever, and in these statements we have the reason for our present electrolytic battery. It is composed of a number of small elements, so arranged that the

driving force may be readily augmented or diminished without shock. Inclosed in a portable case, and furnished at will with various forms of conducting wires and needles, it is arranged to open at the back or end, and all cells are in an inside sliding-case, which can be drawn out of the box to fill or empty without disturbance to plates. I have had a water-tight cistern made to take the place of this box in my instruments which, filled with hot water, raises to the plates as the cells do, and thus easily washes them after each operation. If much surgery is anticipated, one battery should be kept for this purpose alone, thus insuring constant readiness when called upon, if it is properly cared for.

It is necessary to have enough reserve power. An amount of electro-motive force quite sufficient to destroy a nævus or extirpate hairs is utterly incompetent to attack a large tumor like a uterine fibroid, or clotblood in an aneurismal sac. A battery of sixty Grenet cells is occasionally needed, but for practical purposes one of thirty-two is strong enough. With this number freshly charged, everything in the way of surgery may be done, except now and then an immense tumor that is best fitted for a hospital. Of these thirty-two elements only ten or a dozen are usually needed, and it is best to have them so arranged that zero may be at either end of the series, thus wearing the battery out evenly, and making it last a long time.

Conducting cords for electrolysis should be made of copper cables, the ends soldered to tips, not twisted round them. If any loose connections are made, a series of interruptions and consequent shocks will be

the result, and with such a powerful current as is used these are to be carefully avoided.

No rules can be given for shape or size of needles. It is always best to have them made to suit each case, and these are few where a surgeon cannot do this for himself. Nor have I found that insulation of them is of the least benefit practically. On the contrary, it is a hindrance to getting through tough skin, and is unnecessary except where needles are to be used about the face, or wherever it is especially undesirable to leave a scar. For electrolytic removal of large tumors, like scirrhus of the breast, my needles are of steel, six inches long, spear-shaped, with blunt edges and point. Just before using, their handles are insulated by drawing a piece of India-rubber tubing over them, and conducting cable carried to a twist through an eye at the battery end.

For uterine or ovarian fibroids needles are arranged in gangs, connected so that any one or more may be easily detached, made of steel soft enough to avoid fracture, yet stiff enough to bear driving home with a hammer if needed. As they rapidly oxidize before a strong current, they should be made to come away singly for renewal purposes.

Any fine cambric needle may be used for removal of superfluous hairs by electricity, set into an ordinary handle by a drop of solder—a much better way than with a set-screw that is continually slipping.

For nævi, erectile tumors, or stains of skin, needles should be made of platinum, so as to unite a small amount of heat with chemical force; bayonet-pointed, to facilitate introduction, flexible, to avoid breaking, and insulated with hard rubber close up to point,

so that delicate skin may not be injured enough to leave a mark worse than the original disfigurement. It has proven better to have these also made in gangs of three or four, so that a large surface may be attacked without need of making additional sittings.

Electrolytic currents must always be strong enough to accomplish the work to be done. More failures have resulted from timidity in using a novel agent than harm has been done by making it too strong. It is only when needles are plunged into deep-lying organs that danger may come before it can be known, and where great care as to amount of force is demanded, and only then, is any galvanometer needed. A piece of wet litmus paper will tell which needle is positive or acid as well as an elaborate astatic needle, and for all other cases this is all that is needed. Do the work thoroughly. If ten cells do not destroy an adventitious growth, firmly clot an aneurism or nævus, or erectile tumor, use as many as will. Beginning with two, increase force steadily, until every vestige of diseased tissue is burned up, or a soft, pulsating tumor grows tense and resisting as a piece of wood. Take plenty of time. In my early operations nearly every one had to be repeated, because some book or other said that in so many minutes electrolysis would be complete. The only measure of time is completion of the work. Under certain circumstances, such as condensed tissues between needle-points for instance, much longer will be required to do certain work than when circumstances are more favorable. When needles have been fairly introduced, battery immersed, and electrolysis begun,

when gas commences to escape, accompanied by a bubbling, frizzling sound, great patience is necessary. It occurs frequently that progress seems slow, that a soft tumor refuses to grow hard or a hard one to disappear. But chemical action is steadily going on, and will do the work if granted time enough. Very likely the surgeon has but a limited opinion, and still more limited experience of the new force, but he must hold on steadily. There is always a strong temptation to drop needles and turn to knife or ligature. Wait a while. Finally, as the acids around our positive needle-points gather more and more solid constituents from blood around them, and remaining gaseous parts escape, there will come the tense hardness of centre, the dull, livid white of surface that marks the arrest of circulation, the solidification of contents, and a successful result.

Of the many failures that I have made, a very large proportion have been due to this want of patience which is deprecated so strongly here, which later experience taught to be essential, and which would lead to self-reproach but for one comforting fact: failure of electrolysis in no way interferes with subsequent success in other ways. If no good has been done, neither has any harm.

Which needles should be introduced, positive or negative? Remembering that positive means acid, negative alkali, that an acid blood-clot is more resistant and stronger than an alkaline, and that positive action is more rapid than negative, I believe that in all cases of tumors whose contents are less than a cubic inch the positive pole is preferable. In larger masses I introduce several needles connected with

each, and make a current traverse the entire tumor by varying direction of points. Much care must be taken in removing them after an operation is finished. Steel surfaces oxidize quickly, and collect around them a clot that adheres so strongly as to make it risky to exercise enough force to disengage them. I have started hemorrhage several times in this way. The remedy is simple. Just before removal change direction of current by reversing poles, thus making a little tubular vacant space around the former positive, now negative needle, which promptly releases it.

CHAPTER XVII.

URETHRAL AND UTERINE ELECTROLYSIS.

LOOKING over my list of operations, several hundred in number, I see but two that need special description, all others falling within range of these general suggestions; and I think that each surgeon will probably prefer to design his own work. These two are for urethral stricture and uterine fibroids. The galvanic operation for the former was devised at about the same time by Dr. Robert Newman and myself, and fully tabulated by Dr. N., who has had large dispensary experience with it, as well as a great number of private cases.

At a recent meeting of the British Medical Association this operation received much attention, and due credit given to American surgery therefor, but by no means sufficient to Dr. Newman, who emphatically deserves a pioneer's laurels in this new path.

I have recently received several letters of inquiry upon the subject, not only from patients, but from medical men, which exhibit such a dense ignorance of electrical technique as to be worthy of notice.

One of these letters from Maine complains that "the operation for my stricture which you recommended was performed two weeks ago by Dr. ——, and I am just able to be about again. The pain was

agonizing, flow of blood severe, and I am not much better."

Another, from a physician in New Hampshire asks, "Do you use a faradic battery in urethral electrolysis?" Some day, when our medical schools have ceased squabbling over students long enough to consider that the world is moving, they will acknowledge the need of providing at least primary instruction in the surgical applications of the coming force, so that a physician may acquire knowledge of the best electrical means of treating surgical disease, with small addition to his outfit.

But my medical friends say: What is the use of an operation requiring an expert to make it successful, and which general practitioners have neither instruments nor knowledge to perform?

There is the very point, and it is to show these friends how easily they may acquire both instruments and skill by following a few straightforward simple directions that this operation is described in detail.

There is needed for the successful electrolysis of urethral stricture, (*a*) a galvanic battery of low tension, (*b*) an operator who can pass a prostatic catheter, and (*c*) a set of insulated bougies. The only point wherein my friend Newman and I disagree is the first. I believe it is better to have a battery of low tension, *i. e.*, some form of Daniel element, than a bichromate cell of any make. Electrolysis goes on equally well, and much muscular contraction of either voluntary or involuntary fibre is avoided.

But the battery must be galvanic, and a machine that makes a noise in action is not a galvanic battery.

That is a point of distinction that will not be forgotten.

In every country village there is to-day a telegraph office, and the doctor is acquainted with the operator. Ten or a dozen of the cells used therein will give exactly the current I employ in the urethra, and they can be borrowed any evening when the office is closed for the day, thus giving the proper battery at no great expense.

Place the cells in a row, or connect them by a sliding rod; the operator will show how this can be done, so that cell by cell may be added without any jump. Connect the *negative* pole with the bougie, the positive with a piece of common carbon covered with sponge or wash leather, run the bar down to the first cell and all is in readiness.

Be certain about the poles. Any mistake here would insure a failure of the entire operation, for the positive pole does not electrolyze in the urethra, it simply burns through the membrane.

Enter the bougie, of as large size as can pass into the meatus, slowly and steadily *to* the stricture. Press the point gently against the barrier, have the patient hold the positive carbon against the skin at any convenient point, and throw the battery in circuit, cell by cell, ten telegraph cells being enough in a large majority of cases. In a few moments, without any pain to the patient, or other sensation except gentle warmth, the bougie will sink into the obstruction as if going into cheese, and must be allowed to go on without any pushing or twisting of the instrument whatever. As it passes along the canal there will be occasional smarting from mere distention of tender spots, but no attention need be paid to it.

If a second or third stricture be encountered the procedure is the same, and I find that some subsequent irritability of the neck of the bladder is entirely avoided if the battery is disconnected before passing the prostate.

This is the entire operation, which rarely exceeds seven minutes in length, is effective, and leaves the patient as ready to attend to his daily affairs the moment it is over and thenceforward as he was before, and which would have supplanted the frequently unsatisfactory surgery of urethral stricture long ago if surgeons clearly understood its performance and appreciated its results.

For uterine fibroids of the intramural or interstitial type electrolysis is eminently adapted. It has proven both safe and effective in my hands, and I recommend it unhesitatingly, only it is tedious, requiring months of patient work, with slow progress. But in so formidable a disease, where ordinary surgical interference is so difficult, time is not of great value, at least to the patient, and success in saving life is a surgeon's sufficient reward for any amount of labor. I am quite unable to explain the rationale of cure in these cases. There is some influence in electricity that either stimulates absorbents to extraordinary efforts to get rid of abnormal growths, or that dissipates them by its own diffusive power. These are but guesses, however, and so far as I am aware, every attempt to do more than surmise the manner of cure in these cases has resulted in failure. But it is certain that a cure is obtained by this means, and it is less important to know why than to be ignorant of the fact.

Needles for electrolysis of uterine fibroids should be uninsulated, at least five inches long, as thick as a slender knitting-needle, bayonet-pointed, and tempered just enough to make them stiff. Mine are in gangs of six, each one attached to a separate conducting cord, and having a head attached, large enough to be readily grasped by the finger and thumb, or to admit of being struck by a hammer in case of need.

All conducting cords are assembled by a narrow bar, bearing a screw-tip upon one side, which fits into a wooden handle that holds the regular battery cord. I have tried to eliminate this handle, but it is so convenient to be able to add to or subtract from the number of needles during an operation, that bar, handle, and needles remain in my case as I have described them.

The patient may be operated upon either at her own rooms or the surgeon's. As no ether is required, no hemorrhage or shock follows, and no subsequent inflammation is to be feared, it makes little difference where it is done. While comfortably recumbent, a flat, positive sponge electrode is slipped under the patient, and from four to eight needles thrust into the tumor directly through skin and peritoneum. It is surprising how little pain this apparently formidable procedure causes.

They should be introduced nearly to the centre of the tumor, in a ring, points downward, in a line with the positive sponge, and connected with negative pole of a low tension series. From six to ten cells—two to three milliamperes—is sufficient electro-motive force, and an application should not exceed ten min-

utes in length, to be repeated semi-weekly for a month, when an interval of rest may be taken. This vacation will give needle punctures time to heal, and the tumor time to show what impression has been made upon it. Half an hour's rest, with abdomen covered with a cooling lotion, has been the only subsequent treatment in my cases, and after twenty-four hours patients have been permitted to attend to their ordinary avocations.

CASE.—Miss F. D., schoolmistress, aged twenty-six, scrofulous family and some consumptive relatives, came to me in 1876 with a large interstitial uterine fibroid that had been slowly growing for four years. Enlargement was plainly visible through clothing, and upon examination occupied the entire anterior uterine wall. Six needles were introduced into the tumor as above advised and a current equivalent to ten Leclanche cells sent through it for eight minutes. This operation was repeated every other day for six weeks, when the lady was sent home for a month. Resuming treatment it was carried on for a year with similar intervals, with the result of lessening the growth so that it could only be discovered by close examination by conjoined palpation, and was not of the smallest annoyance. From that time until I heard from her last, in 1885, there had been no return of the trouble, and she is now earning a comfortable living keeping a little store.

Apostoli's plan of treating these neoplasms by electric currents of great power was given a trial by me some years ago, and set aside for a less dangerous form of treatment for the following reasons:

There is great and serious risk of subsequent in-

flammation whenever living tissues are traversed by currents strong enough to disperse in all directions from a direct line between poles upon slight differences in *vis a tergo*. The first accident of this kind that happened in America resulted in the death of Mrs. General Burnside, and led to a series of experiments, by which I became satisfied that currents of great electro-motive force became uncontrollable now and then when traversing animal tissues, and that the danger element was great.

It is a matter requiring large experience to manage and maintain so large a battery as will originate a thousand milliamperes when operations are infrequent and an electrical engineer at a distance.

Initial expense of such a battery is beyond the reach of most surgeons who care to use it; and greater than all I have been equally successful with mild currents and small needles; while a general reduction of the tumor requires no greater number of operations with low force than with high.

Where hemorrhage is a leading symptom, I believe that ten milliamperes will control it as well and as positively as five hundred, requiring only a longer application.

Although one or two other reasons might be adduced, these seem to me sufficient to justify the operation as described here rather than the other.

CHAPTER XVIII.

ELECTRO-SURGERY.

SURGICAL operations by electricity have not yet reached any great amount of favor or popularity among the profession at large, for several obvious reasons; the first being that a slight experience with this new method soon convinced conscientious men that they must not only revise many ideas as to operative procedure, but also acquire a working practical knowledge of the new motive force. And the time necessary for such study is denied to most whose position makes their opinion of value to the profession, so that they content themselves with quietly shelving the whole subject for a later day, when problems yet unsolved shall not present so many difficulties to their successors, who will be able to find a battery knife that will be as ready and as little trouble as the steel instrument whose place it will then take.

Many of these obstacles are indeed practically insurmountable at present. Batteries that are powerful enough to do needed work are large, costly, and very difficult of maintenance without constant skilled care, demanding under most auspicious circumstances an amount of time and expense for preparation and space for use, that compare most unfavorably with the neat, handy case of knives and scissors to which we have all grown accustomed.

In hospitals, where sincere and earnest attempts have been made to give electro-surgery a fair trial, they have been in a number of instances defeated by these very lions in the way. Complicated instruments have been left to students' care or turned over to an ignorant janitor, and reported as "not in order," when demanded by the visiting surgeon. Or, in one case that I know of, there was no fluid ready for the cells, and no one in the building was acquainted with the receipt for making it, and the older way was perforce employed.

A considerable amount of practice is required in handling galvano-causty knives or wires to obtain best results. If too much current is shunted on, incandescence and destruction of platinum promptly follows; if not enough, the wire obstinately remains cold and the operator's temper grows hot as minutes pass with patient etherized and everybody waiting. A slip of lowering screw when more heat is needed during an operation—and the wire snaps, leaving the surgeon helpless. Of course no one has acquired necessary practical knowledge of electro-physics to repair breaks at sight, and again the knife—that never fails—comes in to finish up with.

For these reasons and others that are not cited I stated in the first chapter my conviction that it was improbable that a general surgeon could accomplish much in the surgical use of electricity with present means. Nevertheless, without reference to what can be done with proper instruments in proper order, it may be said that no battery is of practical value that cannot heat twenty inches of number seventeen platinum wire to bright red, hold it there for twenty min-

utes, and do it every day in the week. To do this there is required a battery of two piles of great size or one larger than the two together, of alternate plates of zinc and carbon so arranged that all zincs are connected as one pole and all carbons as the other. The current thus produced is of great quantity, but devoid of tension—is the great cannon-shot moving slowly and crushing with mere momentum, quite lacking the high velocity and penetrative quality of swifter rifle-bullet.

For exciting fluid, I have found it best to use one of great decomposing power, such as may be made by combining nitric and sulphuric acids with nitrate of ammonium, bichromate of potash, and water. Internal battery resistance is diminished by bringing plates as near each other as possible without touching, and, as zinc is rapidly destroyed by such powerful fluids as the one alluded to, new plates should be set as soon as those in use grow thin. External resistance in causty batteries is expended in heating the platinum knives or wire, which is done by transmuting electrical force into heat, and, very much as a blacksmith heats an iron by pounding it on an anvil, electricity strikes platinum molecules a series of blows as it forces its way past and between them. Therefore conducting wires should be of large surface capacity, as electricity travels upon the surface of conductors almost altogether, and our quantity current can then concentrate its entire power upon the platinums.

It is always best to have cells so arranged that their immersion is done by the operator. It is practically impossible to make two men's brains work synchronously, and cases constantly arise where a fraction of

a second one way or the other is sufficient to endanger success. Such a battery as this is made by Flemming, of Philadelphia, having a stirrup attachment to raise or lower cells which makes the surgeon independent of an assistant. After a fair trial of several other kinds I believe this to be the only one that fulfils needed demands of staying power and easy handling. But it is non-portable on account of size and weight; no objection to me, however, as I have found no difficulty in making the most important operations at my own rooms. There is something about galvanic surgery that largely obviates shock. Perhaps it is avoidance of hemorrhage, perhaps a compensating quality in electricity, perhaps neither; but the fact remains that I have repeatedly sent patients home an hour after removal of a carcinomatous breast by galvanic wire, who have not been confined to bed at all afterwards, and have done well, and almost all my surgical cases are so treated.

Galvano-causty is adapted to amputation of such tumors as are difficult of access by reason of position or of large blood supply, or both, to external cancerous growths, to nævi, moles and warts, and to all applications of actual cautery. I have practised amputation of the tongue twice and amputation of the cervix uteri eight times without mishaps or trouble, the verdict of my assistants in all cases being favorable. Indeed, to be able to operate in buccal or vaginal cavity without impediment to vision by flowing blood is a comfort one will not willingly dispense with after a single trial; and the eschar made by heated wire has healed as quickly and kindly as similar ones made by the knife or écraseur.

Care must be taken to have every part of the battery in first-class order before beginning. Fresh fluid should be used for every operation of any magnitude, and all connections, springs, etc., be carefully tested. In case of an external tumor, as a breast, I usually make an incision into the skin, not through it, deep enough for the wire to lie in, thereby saving much time. As the wire loop grows smaller with decrease of quantity of tissue within its grasp, the plates should be slowly removed from the fluid, otherwise so much more force will be concentrated upon lessened resistance as to burn the wire through.

For actual cautery purposes, it is superior to any of the older appliances, such as heated iron, having but one competitor in this field, the Paquelin thermo-cautère; and wherever it is needed to use a slender hot point, the galvanic instrument has no equal; for it is placed in position cold, is instantly carried to any desired temperature, and readily maintained there as long as is necessary.

I have found the galvanic wire especially useful in anal fistulas. It is quick, bloodless, and leaves not adherent surfaces, which slough off clean and heal readily, and the wire is easier of introduction than an elastic ligature.

For instruments, there will be needed a galvanic écraseur with four loops of platinum wire twenty inches long, Nos. 15, 17, 18 and 20, a holder with galvanic knife and screw posts for any size wire point, and a long curved double carrier, useful in vagina or throat. Both handles will have buttons for making and breaking connections, and the surgeon can readily devise the rest.

When beginning an operation it will be found best

to heat the wire to desired temperature, and mark roughly how much plate immersion is sufficient to do this, before applying it to flesh.

Bring the plates into an inch more than this depth at once, for contact with cool surfaces will require that much more electricity to produce the same amount of heat than was obtained in air alone, and that will make a good starting point. The first dip will leave a line upon zinc surfaces that will do for a guide.

No time should be lost in removing plates from solution the instant they are through their work, and immersing them in hot water alkalinized with a little ammonia or potash. Let them soak there for an hour and then plunge them into an amalgamating solution, carbons as well as zincs. I have found the following formula a useful mixture for this purpose. Take of commercial nitric acid one pound, commercial muriatic acid two pounds; mix, and let stand in a glass or earthen vessel thirty minutes. Add eight ounces of mercury. After ten hours add three pounds of muriatic acid, and keep in closed glass bottles. This mixture keeps for years, only needing a little more mercury now and then, and will quickly amalgamate any zinc that is placed in it, saving much labor and danger to clothing over the old way.

If prompt care of such large plates as compose a galvano-causty battery be neglected, zincs and connections will be rapidly destroyed by the strong fluid employed, and the machine made useless.

I have written at some length concerning this form of electro-surgery, as much for hospital surgeons who occasionally use it as for information for general surgeons who rarely do.

Even in large institutions it is usual to have an "electrician" sent to operate a galvano-causty battery when one is to be used; and although this is preferable to having an instrument refuse duty when called upon, I am still of the belief that every surgeon should know enough of electrical laws to enable him to put in order a battery so simple as this, to use it understandingly, and to care for it afterwards with just comprehension of its needs.

With this chapter my work is done for the present. Electricity in medicine and surgery, as in arts and as a science, is still in its very babyhood, and it is to be expected that so powerful an agent, one that is receiving such careful attention from brilliant minds in every civilized land, will become more and more useful in the hands of modern physicians, whose professional education and careful training so well fit them to investigate the many new phenomena that are being revealed almost constantly.

Limited in its application by our ignorance of its origin and action, as well as by lack of experience, it offers a fascinating field for study, and a profitable one for practice. As the clouds roll away that yet obscure its nature, and as means for its scientific employment in medicine are multiplied, it will become a leading factor in treatment of disease, and may one

day, who knows? take position in front of all hygienic and sanitary agents. While it is not yet grown, however, to any such magnitude, and is still sub-judice, such directions as have been given in these pages may serve to save time by indicating what has been done, what is being done daily, by men who have devoted their lives to the practical use of electricity in disease.

THE END.

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